Assessing the Environmental Impact of 14 Selected Waste Disposal Sites.

Phase II, Manitoba Landfill Study

Environment Canada

Manitoba
Environment and
Workplace Safety
and Health

ASSESSING THE ENVIRONMENTAL IMPACT OF 14 SELECTED WASTE DISPOSAL SITES.

PHASE II, MANITOBA LANDFILL STUDY

PREPARED FOR:

MANITOBA ENVIRONMENT

AND ENVIRONMENT CANADA

June, 1984

PREPARED BY:

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Geologist

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Executive Summary

Across Canada a number of three phase waste disposal ground environmental assessment projects, now in various stages of completion, have been jointly undertaken by the Federal and Provincial Governments. In late 1983, the Manitoba phase two assessment of 14 of 22 selected waste disposal grounds was developed, in-house, by a term employee under the direction of the Federal Provincial Steering Committee.

The major objective of this phase of the study was to investigate these waste disposal sites in sufficient detail in order to determine their potential impact on the environment.

For each of the 14 selected sites, site visits were conducted and technical data reviews carried out. A field investigation was than formulated for each site, in conjunction with the project Steering Committee. In some cases in-depth field investigation was not necessary. Groundwater contamination, surface water pollution and methane gas production were the main parameters investigated throughout this phase two study. Recommendations and conclusions for each site have been based on the study findings and Manitoba Regulation 208/76 a regulation under the Clean Environment Act respecting waste disposal grounds.

After the initial site visits and data review it was decided that two sites, one a facility under Federal Jurisdiction located on the Little Black River Indian Reserve and the other located within the Rural Municipality of Shellmouth, would no longer be considered as potential concern sites and, therefore, in depth field investigations were not necessary. Various recommendations have been made with regard to Manitoba Regulation 208/76 and the observations made during the site visits and it is suggested that these recommendations be followed.

Through discussion with the Steering Committee it was decided that because of the difficulties and costs of conducting the complete field investigation formulated for two sites, Swan River and Winnipegosis, the subsurface component of the field work would be postponed. The results and conclusions of the work carried out to date at these two sites indicates that the completion of the investigations should be undertaken in the near future. Various recommendations have been made with regard to Manitoba Regulation 208/76 and the results of the study findings so far and it is suggested that these recommendations be carried out.

Subsurface test drilling and monitoring well installation were not necessary at the Stonewall site. This decision was made because of the availability of information concerning this area and the number of groundwater monitoring points in close proximity to this waste disposal area. It is recommended, however, that a methane gas investigation be conducted at this site because of the buildings located on the abanded waste disposal area.

With regard to the following six sites; Mariapolis, Douglas, Ninette, Neepawa, Rapid City and Baldur - phase two assessment of these sites indicated that there is no observed effect on the surrounding environment. Data collected throughout the study also shows no hazard to the public health which can be directly attributed to these waste disposal grounds. However, various recommendations have been made with regard to Manitoba Regulation 208/76 and the results of the study. It is suggested that these recommendations be carried out.

Two sites, Napinka and Rivers, show signs of localized environmental damage caused by leachates from the waste disposal facilities entering the underlying aquifers. Further detailed monitoring may be carried out at these sites, but suggestions as to site relocation should be considered. Recommendations made with regard to Manitoba Regulation 208/76 and the site field investigations should also be undertaken.

Because of the close proximity of the Miniota sewage lagoon to the Miniota waste disposal ground, both of these facilities have to be considered when investigating environmental and health concerns at this particular site. In this case environmental damage caused by leachate from the waste disposal ground getting into the underlying sand and gravel aquifer is compounded by the leakage of sewage from the sewage lagoon to the same aquifer. Further detailed monitoring may be carried out at this site, but suggestions as to site relocation for both the sewage lagoon and the waste disposal facility should be considered. Lining the sewage lagoon with an impermeable liner would alleviate some of this condition and should also be considerred. Other recommendations have been made with regard to Manitoba Regulation 208/76 and observations made during the investigation and it is suggested that these recommendations be followed.

1.0 Introduction

Throughout Canada joint projects between Provincial Environmental Agencies and the Federal Environmental Protection Service, to evaluate land disposal sites, are being undertaken because of concerns with public health and environmental problems.

In Manitoba, 760 active and inactive waste disposal sites were identified in the 1982 I.D. Systems Report "Identification and Verification of Active and Inactive Land Disposal Sites in Manitoba". Of these, 22 higher priority sites were chosen through a study by a private consultant G. M. Trask. The 1983 report, "Review and Evaluation of Selected Land Disposal Sites" details this priority site selection.

Of the 22 higher priority sites 14 were selected for further in-house investigative work, and 8 were contracted out to private consultant firms.

The objective of this phase was to investigate the waste disposal sites in sufficient detail in order to determine the manifested potential impact on the environment. These investigations included:

A) - A site visit.

B) - Confirmation of site location.

C) - Confirmation of geographic conditions.

D) - Air photo and map interpretation.

E) - Inspection of the area in and around the site.

F) - Test hole drilling to confirm surficial geologic conditions at selected sites.

G) - Installation of groundwater monitoring wells at selected sites.

H) - Monitoring of ground and surface waters and methane gas production, in order to determine the environmental impact of each site.

I) - Review and evaluation of all technical data pertaining to each site.

This report details the in-house phase two work, and the results and conclusions of the investigations.

2.0 Methods

The following methods were used in order to evaluate the environmental and health concerns of each of the 14 sites studied.

A) - A site visit was conducted to each of the sites between August 11 and August 24, 1983.

B) - A review of the evailable technical data for each site was undertaken.

C) - All of the accumulated data was reviewed with the project steering committee in late August of 1983. This led to the formulation of the appropriate field investigation for each site.

D) - Test hole drilling and groundwater monitoring well installation took place at selected sites between October 31 and November 9, 1983.

E) - Groundwater sample collection was carried out at selected local residences and the installed monitoring wells on two occasions, the first between October 31 and November 22, 1983 and the second between January 10 and January 17, 1984.

F) - A final review and evaluation of the collected data and the compilation of this report detailing the findings of the above research methods.

3.0 Site Specifics

This section of the report is broken down into 14 parts numbered 3.1 to 3.14. Each part details the information gathered and the results and conclusions of the work carried out for each site studied.

Figure 1 is a Provincial Map indicating the boundaries of the rural Municipalities and the Local Government Districts in Manitoba. Each of the districts where a site evaluation was undertaken has been identified on the map. The numbers used to identify each site corresponds to the following sections of the report.

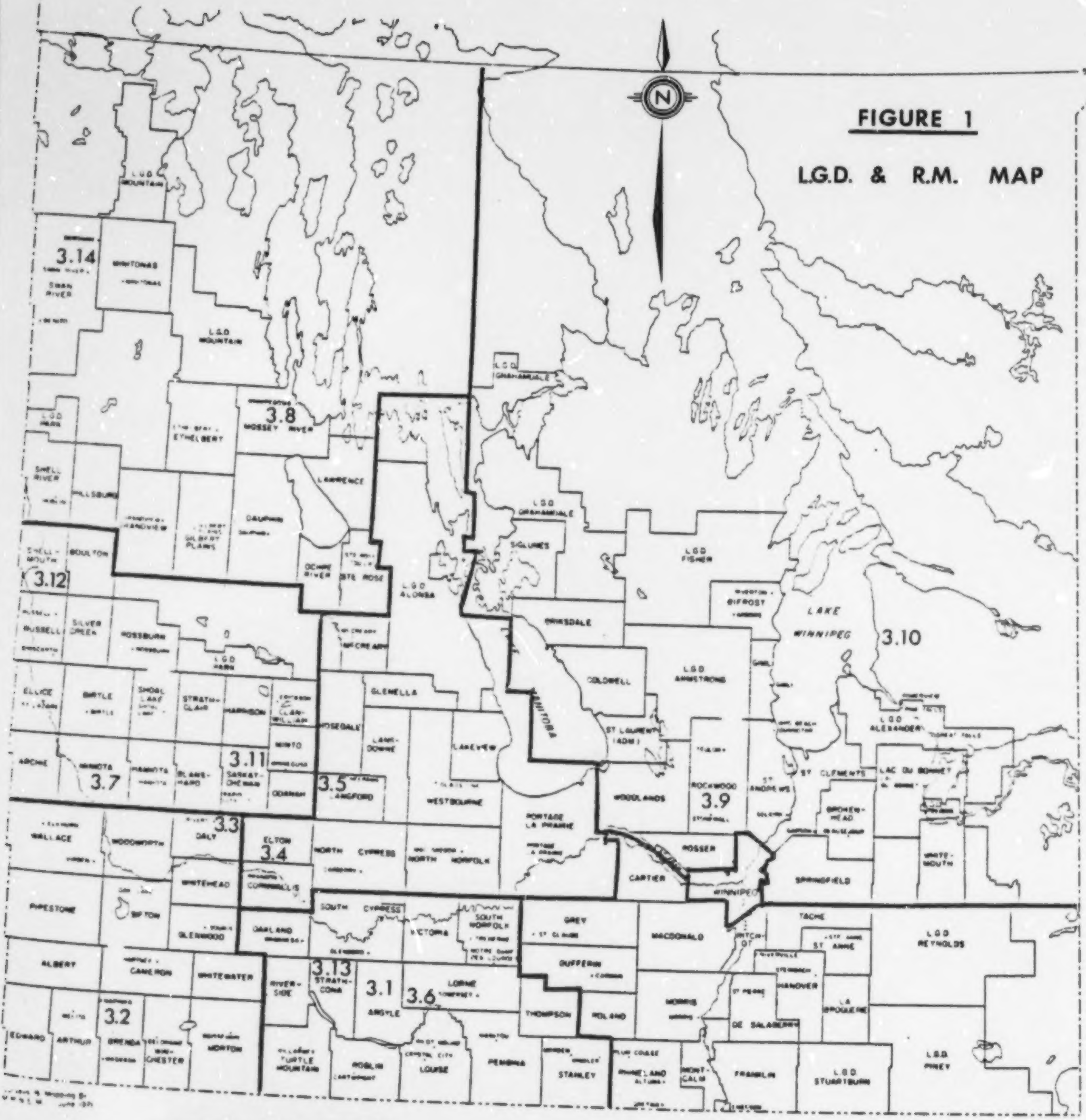


FIGURE 1

L.G.D. & R.M. MAP

N
LAKE WINNIPEG
MANITOBA
3.1
3.2
3.3
3.4
3.5
3.6
3.7
3.8
3.9
3.10
3.11
3.12
3.13
3.14
L.G.D. MOUNTAIN
MINITONAS
SWAN RIVER
MOSSEY RIVER
ETHELBERT
SHELL RIVER
HILLSBURG
GRANDVIEW
GILBERT PLAINS
DAUPHIN
LAWRENCE
OCHRE RIVER
STE ROSE
SHELLMOUTH
BOULTON
L.G.D. ALONSA
L.G.D. GRAHAMDALE
SIGLUNES
L.G.D. FISHER
BIFROST
RUSSELL
SILVER CREEK
ROSSBURN
L.G.D. PARK
MCCREARY
ERIKSDALE
COLDWELL
L.G.D. ARMSTRONG
GIMLI
ELLICE
BIRTLE
SHOAL LAKE
STRATHCLAIR
HARRISON
CLANWILLIAM
GLENELLA
ROSEDALE
LANSDOWNE
LAKEVIEW
ST LAURENT
L.G.D. ALEXANDER
ARCHIE
MINIOTA
HAMIOTA
BLANSHARD
SASKATCHEWAN
MINTO
ODANAH
LANGFORD
WESTBOURNE
WOODLANDS
ROCKWOOD
ST ANDREWS
ST CLEMENTS
LAC DU BONNET
BROKENHEAD
WALLACE
WOODWORTH
DALY
ELTON
NORTH CYPRESS
NORTH NORFOLK
PORTAGE LA PRAIRIE
ROSSER
WHITEMOUTH
PIPESTONE
SIFTON
WHITEHEAD
CORNWALLIS
CARTIER
WINNIPEG
SPRINGFIELD
SOUTH CYPRESS
VICTORIA
SOUTH NORFOLK
GREY
MACDONALD
RITCHOT
TACHE
STE ANNE
L.G.D. REYNOLDS
GLENWOOD
OAKLAND
DUFFERIN
HANOVER
ALBERT
CAMERON
WHITEWATER
RIVERSIDE
STRATHCONA
ARGYLE
LORNE
THOMPSON
ROLAND
MORRIS
ST PIERRE
LA BROQUERIE
DE SALABERRY
EDWARD
ARTHUR
BRENDA
WINCHESTER
MORTON
TURTLE MOUNTAIN
ROBLIN
LOUISE
PEMBINA
STANLEY
RHINELAND
MONTCALM
FRANKLIN
L.G.D. STUARTBURN
L.G.D. PINEY

IDENTIFICATION NUMBERS

3.1 Baldur, R.M. of Argyle (2)
3.2 Napinka, R.M. of Brenda (1)
3.3 Rivers, R.M. of Daly (1)
3.4 Douglas, R.M. of Elton (1)
3.5 Neepawa, R.M. of Langford (2)
3.6 Mariapolis, R.M. of Lorne (5)
3.7 Miniota, R.M. of Miniota (1)
3.8 Winnipegosis, R.M. of Mossey River (1)
3.9 Stonewall, R.M. of Rockwood (8)
3.10 Little Black River Indian Reserve (3)
3.11 Rapid City, R.M. of Saskatchewan (1)
3.12 Shellmouth, R.M.of Shellmouth (4)
3.13 Ninette, R.M. of Strathcona (4)
3.14 Swan River, R.M. of Swan River (2)

Numbers in parentheses coincide with phase I identification numbers.

3.1

BALDUR WASTE DISPOSAL GROUND

SE-11-5-14W

R.M. of ARGYLE #2

3.1 Baldur Waste Disposal Ground

3.1.1 Location

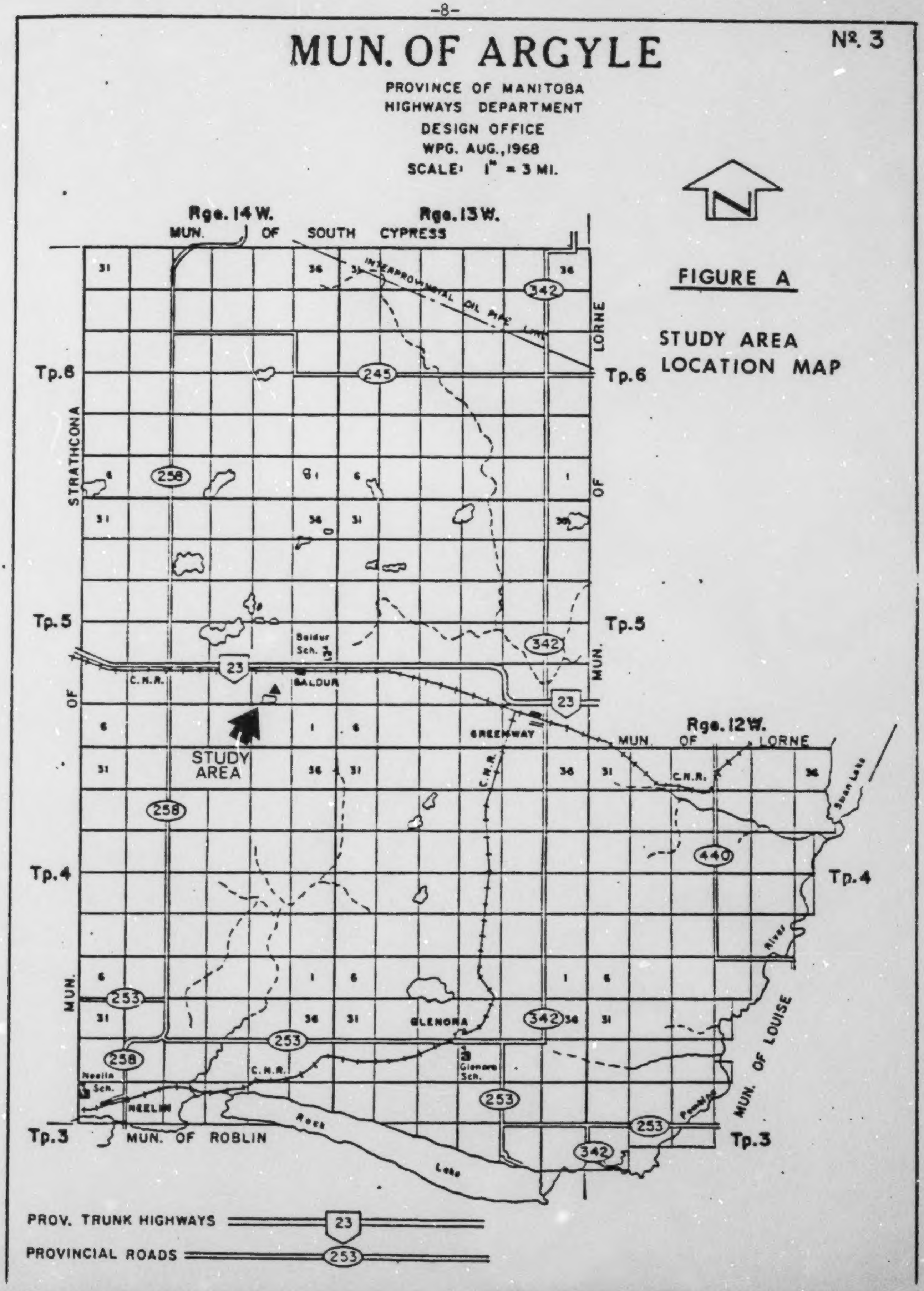
The community of Baldur, Manitoba is located within the Rural Municipality of Argyle, approximately 140 kilometres south-west of Winnipeg along PTH 23. The waste disposal area is located about 1 kilometer south-west of the community and the legal discription of the site is SE-11-5-14W.

Figure A is a Rural Municipality Map locating the study area and the Community of Baldur within the Rural Municipality of Argyle.

3.1.2 Physiography

This region is characterized by swell and swail topography, gentle rolling prairie made up of ground moraine having low relief and gentle slopes. The depressions in this type of topography are often slightly marshy and can often be interconnected.

Many small creeks and small swampy lakes can be observed in the vacinity of Baldur. These creeks and lakes may be classified as intermittent as they are very often dry. This network of depressional waterways represent the surficial drainage for the area, eventually reaching Swan Lake to the east or the Cypress River system to the north-east.



MUN. OF ARGYLE

Nº. 3

PROVINCE OF MANITOBA
HIGHWAYS DEPARTMENT
DESIGN OFFICE
WPG. AUG., 1968
SCALE: 1" = 3 MI.

FIGURE A

STUDY AREA LOCATION MAP

Rge. 14 W.
Rge. 13 W.
Rge. 12 W.
MUN. OF SOUTH CYPRESS
INTERPROVINCIAL OIL PIPE LINE
MUN. OF LORNE
MUN. OF STRATHCONA
MUN. OF LOUISE
MUN. OF ROBLIN
Tp. 6
Tp. 5
Tp. 4
Tp. 3
342
245
258
23
440
253
C.N.R.
Baldur Sch.
BALDUR
GREENWAY
STUDY AREA
GLENORA
Glenora Sch.
Neelin Sch.
NEELIN
Rock Lake
Swan Lake
Pembina River
31
36
1
6
PROV. TRUNK HIGHWAYS
PROVINCIAL ROADS

3.1.3 Site Conditions

During the site visit on August 16, 1983, a number of observations were made with regard to the Baldur waste disposal facility. Pictures taken during the site visit serve to illustrate the conditions in and around the active area of disposal. These pictures can be found in Appendix A, along with a detailed description of each view.

The disposal site covers an area of approximately 213 metres in length, (east to west) by 91 metres in width, (north to south). This area is fenced in by a 1 metre high barbed wire enclosure. Access to the area is by a gravel road approximately .8 kilometres south of Baldur running west off the Government Road allowance. A sign at the entrace to the access gives instructions on dumping procedures allowed at the waste disposal site.

The active dump area is a pit 49 metres long by 19 metres wide and approximately 3.6 metres deep. From the information gathered during phase one of this study it was learned that various types of wastes are dumped at this site. General municipal waste, septic tank sludge and hospital waste are routinely disposed of here.

While at the site it was observed that many pesticide containers had been deposited in the active pit. Burning of the waste at the site was ongoing and liquid was contained in the pit. A separate section of the disposal area was reserved for bulky metals, for example, car bodies, stoves, etc. A number of fairly large piles of cover fill material were available on the site. Figure B details the plan view of the site.

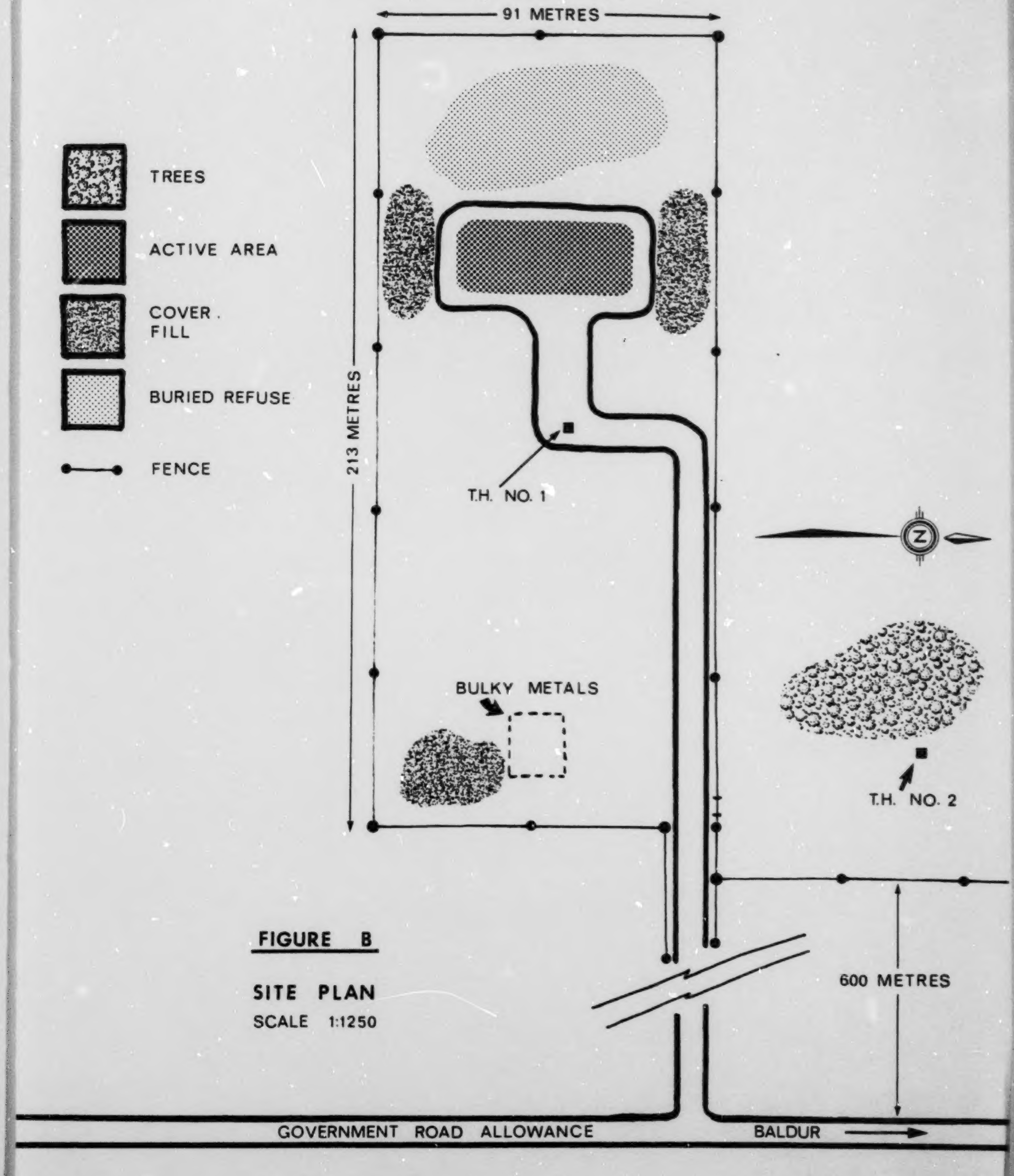

91 METRES
213 METRES
TREES
ACTIVE AREA
COVER FILL
BURIED REFUSE
FENCE
T.H. NO. 1
BULKY METALS
T.H. NO. 2
Z
600 METRES
GOVERNMENT ROAD ALLOWANCE
BALDUR

FIGURE B

SITE PLAN

SCALE 1:1250

3.1.4 Surficial Geology and Hydrogeology

In general the surficial geology around the Baldur waste disposal area can be directly related to a glacial environment. Unsorted glacial debris 1 to 10 metres thick are common for this area. This material is predominately lodgement till, but includes areas of hummocky stagnation morrain ribbed morrain and water deposited till. This till is highly calcareous and is derived primarily from carbonate rock. A typical composition for this type of material is: 44% silt, 21% sand, 19% clay and 16% gravel. Some small bedrock outcrops may be encountered in places where glacial action has removed the surficial materials.

The bedrock in this area is commonly hard shale, with numerous fracture zones. This shale is the most common source of groundwater in this region, with well depths ranging from 8 to 40 metres. Some water bearing sand and gravel lenses may be encountered from place to place, but are infrequently the source of domestic water supplies.

The Water Resources Branch, Department of Natural Resources, Province of Manitoba was requested to complete a groundwater pollution hazard appraisal for the Baldur waste disposal facility. A copy of this appraisal can be found in Appendix B. Basically, the comments made on the appraisal agree with the above general geology. The disposal site is located in an region designated as a groundwater pollution hazard area because some of the shallow sand and gravel deposits known to be in this area are within 5 metres of the ground surface. A field investigation of the waste disposal site was suggested by the Water Resources Branch to confirm the geologic conditions directly below the landfill site. This approach agrees with the method of investigation formulated for this site after the initial site visit.

On November 8, 1983 two 12 meter deep test holes were drilled at the Baldur waste disposal ground using the mud rotary drilling method. Because no significant, shallow, sand, gravel or shale deposits were encountered, monitoring wells were not installed at these drill sites. Geologic logs for the holes drilled can be found in Appendix C. Soil samples taken during the test drilling program have been retained for future reference. The test hole locations can be found on Figure B.

3.1.5 Groundwater Sampling

On November 8, 1983 and again on January 10, 1984 groundwater samples were collected from three residences close to the waste disposal area, two samples approximately 800 metres west and one sample 800 metres north of the site. These samples were submitted to the W. M. Ward Technical Services Laboratory for analysis. Bacteriological samples were submitted to the Cadham Provincial Laboratory for testing. The results of these analyses can be found in Appendix D.

Figure C is an air photo of the study area at a scale of 1:15840. This photo shows the location of the disposal site with respect to the Town of Baldur. The groundwater sampling points established during the field investigation of this waste disposal site have been located on this air photo.

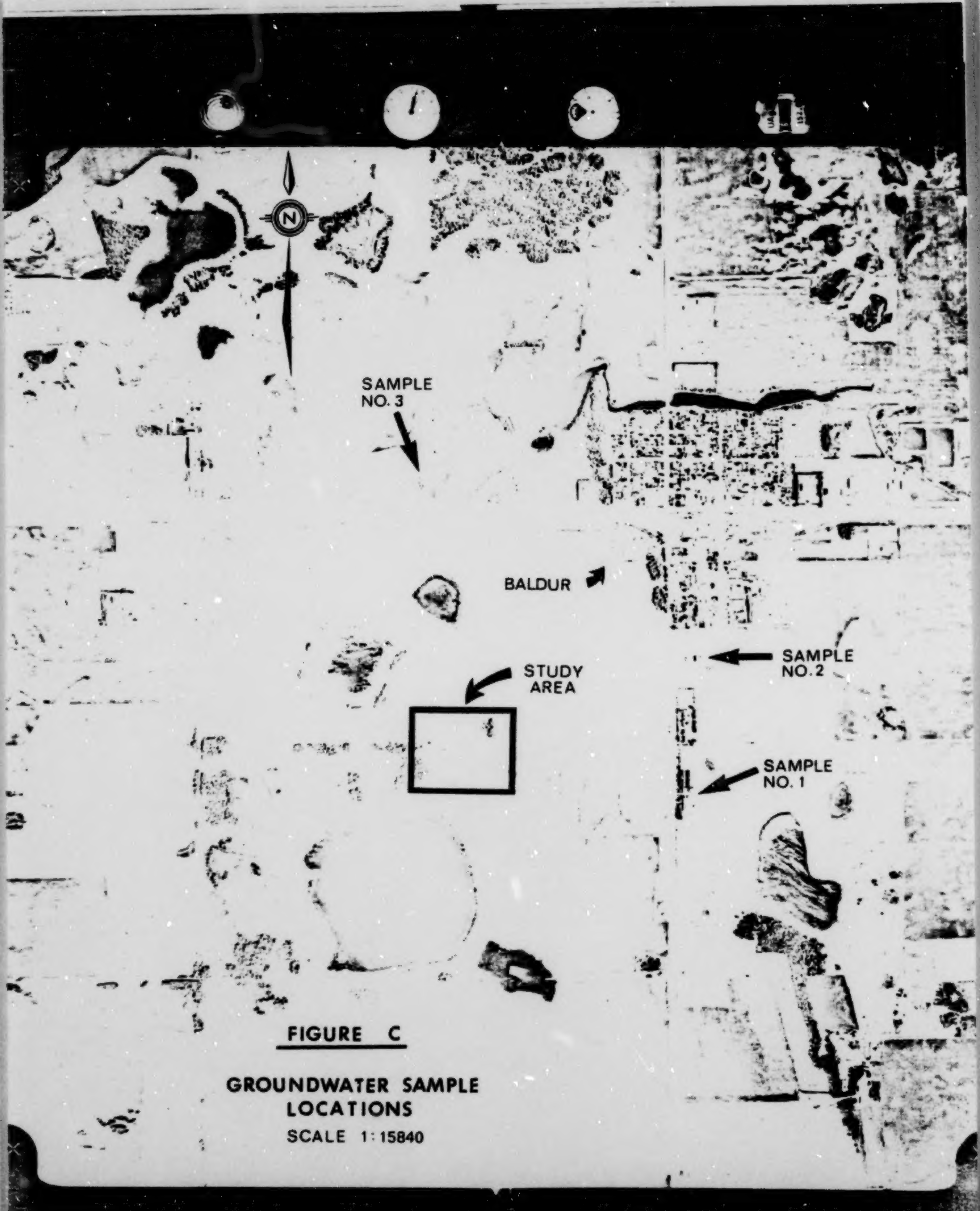

N
SAMPLE NO. 3
BALDUR
SAMPLE NO. 2
STUDY AREA
SAMPLE NO. 1

FIGURE C

GROUNDWATER SAMPLE LOCATIONS
SCALE 1:15840

3.1.6 Analytical Results and Conclusions

With regard to the Baldur waste disposal facility and the phase two assessment of the site, there is no observed effect on the surrounding environment. Data collected throughout the study shows no hazard to the public health which can be directly attributed to the waste disposal ground.

Groundwater

Because the site is considered to be in a groundwater pollution hazard area, a test drilling program was established to identify the surficial geologic and hydrogeologic conditions directly in and around the site. Surface deposits at this particular site contain a high percentage of clays and are therefore fairly impermeable. Up to 12 metres of till overlies the fractured shale bedrock used by most of the local residents for domestic water.

Water quality analyses conducted on some local domestic water supplies were compared to the "Guidelines For Canadian Drinking Water Quality" prepared by Health and Welfare Canada in 1978. These groundwater supplies can be described in general as good quality for domestic purposes. The only parameter of health significance was the sample #2 nitrate count which, on both occasions sampled, was above the maximum acceptable limit. These results cannot be attributed to the waste disposal site.

These test drilling observations and laboratory results indicate that groundwater contamination is not a problem with respect to the Baldur waste disposal facility.

Methane

Methane gas produced through the decomposition of buried domestic waste can be of concern to buildings located in close proximity to waste disposal sites. In this case however, because of the soil conditions and the distance to the nearest dwelling, approximately 800 metres, methane production if any is not a concern.

It should be noted that explosimeter tests for methane gas were conducted during the test drilling program and no positive readings were recorded.

Surface Water

Surface water pollution from the waste disposal ground is not likely to occur at this particular site. Most of the creeks and swamps characteristic of this area are intermittent and too distant to be of concern. The nearest of these depressional swampy lakes is about 150 metres to the south of the disposal site. Pollution from groundwater migration to the surface water is unlikely because of the surficial soil characteristics. Surface runoff from waste facilities practicing above grade disposal may cause pollution problems with surface waters. In the case of the Baldur waste facility the trench and fill method of operation eliminates this concern.

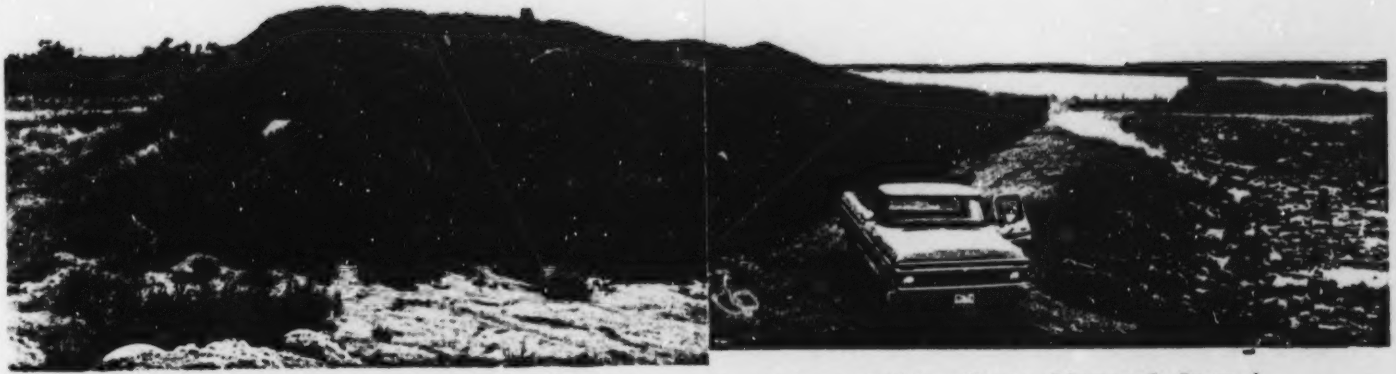
3.1.7 Recommendations

1) All pesticide containers should be drained, crushed and stored in a separate area away from the active disposal trench. Crushing

the containers reduces the size of storage area required to hold the empty cans. Draining the cans reduces the risk of environmental pollution from pesticide residues. All drainings should be collected and disposed of in an approved manor.

2) If septic sludge and sewage wastes are dumped in the active pit, as reported in phase 1 of this study, these wastes would contribute to the amount of liquid sitting in the waste disposal trench. This could prove to be of some environmental and health concern. This practice should be stopped. A liquid waste disposal facility within the disposal area should be constructed for this purpose.
3) All bulky metals should be stored in a separate, above grade, compound away from the active area.
4) Refer to Manitoba Regulation 208/76 under the Clean Environment Act for further clarification of these recommendations; and other waste disposal ground operating procedures.

APPENDIX A



Date: August 16, 1983 Location: Baldur Waste Disposal Ground

Orientation: South side of the disposal area looking north.

Comments: Large pile on the left hand side of the picture is believed to be the old waste disposal area, now burried and covered with vegitation.

Date: August 16, 1983 Location: Baldur Waste Disposal Ground

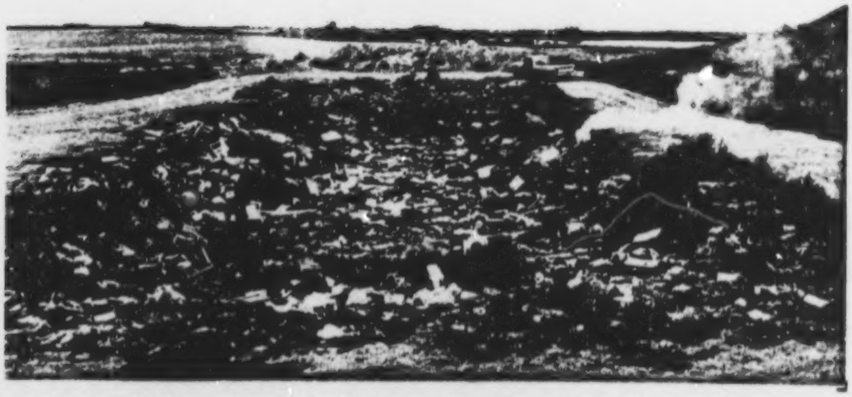
Orientation: South side of the disposal area looking north.

Comments: Active disposal trench. Some pesticide cans can be seen in the trench. Fairly large amount of liquid is contained in the pit. A pile of cover, fill material can be seen north of the pit.

Date: August 16, 1983 Location: Baldur Waste Disposal Ground

Orientation: South side of the disposal area looking east.

Comments: A small metals pile can be seen in the center of the picture. The fence that surrounds the site can be seen on the right hand side of the photograph.



Date: August 16, 1983 Location: Baldur Waste Disposal Ground

Orientation: North side of the disposal area looking south.

Comments: Some bulky metals in active trench. Liquid in the active area may contain sewage waste. Open burning is evident. Note small lake in the background.

Date: November 8, 1983 Location: Baldur Waste Disposal Ground

Orientation: North-east at access road looking south-west.

Comments: Drilling of test hole #1

APPENDIX B

FILE NO. 5.7.4.2.

WATER RESOURCES BRANCH

GROUNDWATER POLLUTION HAZARD APPRAISAL

POTENTIAL SOURCE OF POLLUTION	Waste Disposal Ground
LOCATION OF SOURCE	SE11-5-14W
OWNER OF SOURCE	R.M. of Argyle, Baldur.

GEOLOGICAL CONDITIONS	SURFICIAL DEPOSITS	From 5 m to 13 m of glacial till with some layers of sand and gravel.
	BEDROCK	Shale, hard with fractured zones.

GROUNDWATER CONDITIONS	AQUIFERS	The fractured zones in the shale constitute the most common aquifer in the area. The sand and gravel layers may be water bearing at some locations.
	WELLS	Most of the wells reported in the vicinity draw water from the shale aquifer. Well depth ranges from 10 m to more than 40 m.

POLLUTION HAZARD

Because some of the sand and gravel is less than 5 m below ground level, this quarter and the immediate vicinity are classified as a groundwater pollution hazard area.

COMMENTS

A field investigation to assure that the waste disposal area is not located in an area underlain by shallow sand and gravel or shale aquifers would be advisable.

BY: ______ GROUNDWATER GEOLOGIST M. Rutulis, P. Eng.

DATE: Dec. 7/83

APPENDIX C

GEOLOGIC LOG

Test Hole Identification: Baldur TH #1

Location: Baldur, Manitoba. R.M. of Argyle

Legal Description: SE-11-5-14W

Date: November 8, 1983

Time: 2:15 P.M. to 3:00 P.M.

Total Depth: 12 Metres

Type Of Casing: N/A

Type Of Screen: N/A

Depth	Description
0 to 1.5 m.	Brown clay till, some fine gravel.
1.5 to 4.6 m.	Dark brown clay till, some fine gravel and coarse sand.
4.6 to 6.1 m.	Dark grey clay.
6.1 to 9.1 m.	Dark grey clay, some shale and some fine sand.
9.1 to 10.6 m.	Dark grey clay, very small amount of shale.
10.6 to 12.2 m.	Dark grey clay, some fine brown gravel and some shale.

GEOLOGIC LOG

Test Hole Identification: Baldur TH # 2

Location: Baldur, Manitoba. R.M. of Argyle

Legal Description: NE'-11-5-14W

Date: November 8, 1983

Time: 3:15 P.M. to 4:00 P.M.

Total Depth: 12 Metres

Type Of Casing: N/A

Type Of Screen: N/A

Depth	Description
0 to 1.5 m.	Brown clay till, small amounts of sand and gravel.
1.5 to 3.0 m.	Brown clay, some coarse sand and gravel.
3.0 to 4.6 m.	Brown clay mixed with shale, small amount of gravel.
4.6 to 9.1 m.	Grey clay, fair amount of hard shale 35 to 40%.
9.1 to 10.6 m.	Grey clay,very little shale.
10.6 to 12.2 m.	Shale, both hard and soft, very little clay if any.

APPENDIX D

Water Quality Analysis

Project: Phase II Landfill Study

Location: Baldur, R.M. of Argyle SW-12-5-14W

Sample #: 1

Date: Result A; November 8, 1983 Result B; January 12, 1984

Parameter	Result A	Result B	Measured Unit
Conductivity	1610.00	1610.00	umho/cm
Residue Total	1090.00	1120.00	mg/l
Residue Filterable	1090.00	1120.00	mg/l
Residue Non Filterable	L 5.00	L 5.00	mg/l
pH	7.40	7.30	units
Alkalinity Total (CaCO3)	418.00	402.00	mg/l
Alkalinity (HCO3)	510.00	490.00	mg/l
Alkalinity (CO3)	0.00	0.00	mg/l
Alkalinity (OH)	0.00	0.00	mg/l
Arsenic, As	L 0.001	L 0.001	mg/l
Cadmium, Cd	L 0.001	L 0.001	mg/l
Copper, Cu	0.06	0.03	mg/l
Lead, Pb	L 0.005	L 0.005	mg/l
Zinc, Zn	0.64	0.57	mg/l
Chromium, Cr	0.005	L 0.005	mg/l
Calcium, Ca	150.00	149.00	mg/l
Magnesium, Mg	104.00	100.00	mg/l
Hardness (CaCO3)	803.00	784.00	mg/l
Manganese, Mn	0.10	0.11	mg/l
Iron, Fe	0.07	0.04	mg/l
Sodium, Na	62.40	59.00	mg/l
Color	5.00	-	units
Turbidity	0.75	0.30	NTU
Cyanide, CN	L 0.02	L 0.02	mg/l
NO3-NO2-N	5.00	4.30	mg/l
Chloride, Cl	150.00	146.00	mg/l
Sulphate, SO4	250.00	250.00	mg/l
Coliform Group	-	L 1.00	per 100 ml
Fecal Coliform	-	L 1.00	per 100 ml

L = Less Than

G = Greater Than

Water Quality Analysis

Project: Phase II Landfill Study

Location: Baldur, R.M. of Argyle NW-12-5-14W

Sample #: 2

Date: Result A; November 8, 1983 Result B; January 12, 1984

Parameter	Result A	Result B	Measured Unit
Conductivity	1050.00	980.00	umho/cm
Residue Total	670.00	640.00	mg/1
Residue Filterable	670.00	640.00	mg/1
Residue Non Filterable	L 5.00	L 5.00	mg/1
pH	7.45	7.45	units
Alkalinity Total (CaCO3)	430.00	402.00	mg/1
Alkalinity (HCO3)	525.00	490.00	mg/1
Alkalinity (CO3)	0.00	0.00	mg/1
Alkalinity (OH)	0.00	0.00	mg/1
Arsenic, As	L 0.001	L 0.001	mg/1
Cadmium, Cd	L 0.001	L 0.001	mg/1
Copper, Cu	0.06	0.08	mg/1
Lead, Pb	L 0.005	L 0.005	mg/1
Zinc, Zn	0.20	0.22	mg/1
Chromium, Cr	0.006	L 0.005	mg/1
Calcium, Ca	71.90	62.30	mg/1
Magnesium, Mg	68.20	56.60	mg/1
Hardness (CaCO3)	460.00	389.00	mg/1
Manganese, Mn	L 0.02	L 0.02	mg/1
Iron, Fe	0.03	0.02	mg/1
Sodium, Na	91.00	79.40	mg/1
Color	L 5.00	-	units
Turbidity	0.60	0.30	NTU
Cyanide, CN	L 0.02	L 0.02	mg/1
NO3-NO2-N	17.00	11.40	mg/1
Chloride, Cl	17.00	14.00	mg/1
Sulphate, SO4	75.00	71.00	mg/1
Coliform Group	-	L 1.00	per 100 ml
Fecal Coliform	-	L 1.00	per 100 ml

L = Less Than

G = Greater Than

Water Quality Analysis

Project: Phase II Landfill Study

Location: Baldur, R.M. of Argyle SE-14-5-14W

Sample #: 3

Date: Result A; November 8, 1983 Result B; January 12, 1984

Parameter	Result A	Result B	Measured Unit
Conductivity	819.00	825.00	umho/cm
Residue Total	520.00	550.00	mg/l
Residue Filterable	510.00	550.00	mg/l
Residue Non Filterable	10.00	7.00	mg/l
pH	7.35	7.30	units
Alkalinity Total (CaCO3)	336.00	322.00	mg/l
Alkalinity (HCO3)	410.00	393.00	mg/l
Alkalinity (CO3)	0.00	0.00	mg/l
Alkalinity (OH)	0.00	0.00	mg/l
Arsenic, As	L 0.001	L 0.001	mg/l
Cadmium, Cd	L 0.001	L 0.001	mg/l
Copper, Cu	L 0.01	L 0.01	mg/l
Lead, Pb	L 0.005	L 0.005	mg/l
Zinc, Zn	0.25	0.23	mg/l
Chromium, Cr	L 0.005	L 0.005	mg/l
Calcium, Ca	60.40	61.20	mg/l
Magnesium, Mg	35.00	34.00	mg/l
Hardness (CaCO3)	295.00	293.00	mg/l
Manganese, Mn	0.48	0.47	mg/l
Iron, Fe	3.98	4.37	mg/l
Sodium, Na	96.50	90.40	mg/l
Color	L 5.00	-	units
Turbidity	25.00	30.00	NTU
Cyanide, CN	L 0.02	L 0.02	mg/l
NO3-NO2-N	0.40	L 0.01	mg/l
Chloride, Cl	15.00	15.00	mg/l
Sulphate, SO4	95.00	105.00	mg/l
Coliform Group	-	L 1.00	per 100 ml
Fecal Coliform	-	L 1.00	per 100 ml

L = Less Than

G = Greater Than

3.2

NAPINKA WASTE DISPOSAL GROUND

SW-29-4-25W

R.M. OF BRENDA #1

3.2 Napinka Waste Disposal Ground

3.2.1 Location

The community of Napinka, Manitoba is located within the Rural Municipality of Argyle, approximately 270 kilometres south-west of Winnipeg along P.R. 447. The waste disposal area is located about .4 kilometres north-east of the community and the legal discription of the site is SE-11-5-14W.

Figure A is a Rural Municipality Map locating the study area and the Village of Napinka within the Rural Municipality of Brenda.

3.2.2 Physiography

This region is characterized by deep basin sedimentary deposits forming extensive lake plains. These sediments are deposited in a proglacial or glacial environment creating a discontinuous veneer reflecting the form of the underlying bedrock topography.

Very little relief can be observed in this area, some gently sloping creek and drainage channels are common. Surficial drainage for the area north-east of Napinka is a small creek connected to the Souris River system. Regional drainage, is again, in a north-easterly direction.

3.2.3 Site Conditions

During the site visit on August 18, 1983, a number of observations were made with regard to the Napinka waste disposal

MUN. OF BRENDA

NO. II

PROVINCE OF MANITOBA
HIGHWAYS DEPARTMENT
DESIGN OFFICE
WPG. AUG, 1968
SCALE : 1" = 3 MI.

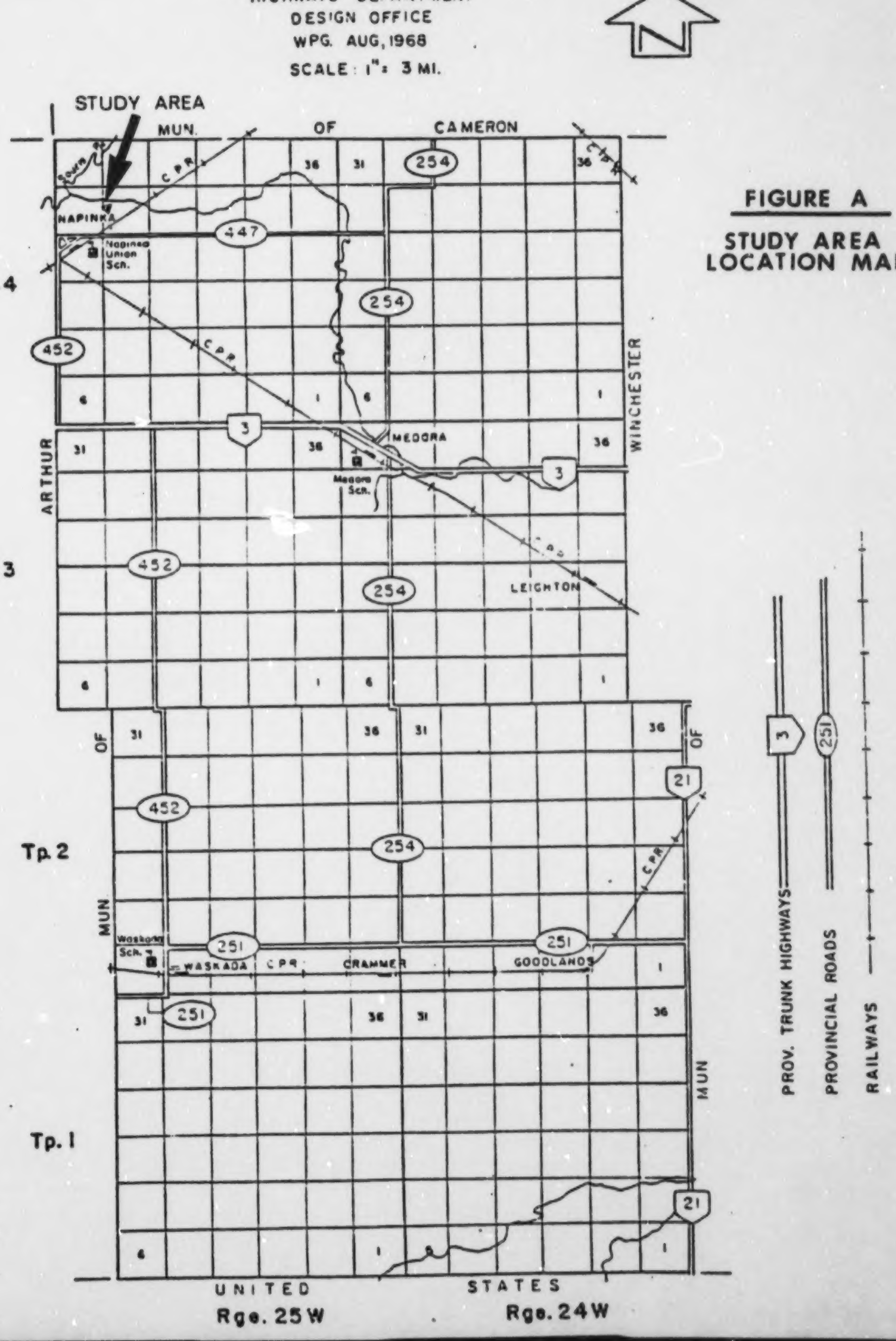

N
STUDY AREA
MUN. OF CAMERON
NAPINKA
Napinka Union Sch.
C.P.R.
Souris R.
254
447
452
3
251
21
MEDORA
Medora Sch.
LEIGHTON
Waskada Sch.
WASKADA
CRAMMER
GOODLANDS
ARTHUR
MUN OF
WINCHESTER
OF MUN
Tp. 4
Tp. 3
Tp. 2
Tp. 1
31
36
6
1
UNITED STATES
Rge. 25 W
Rge. 24 W
PROV. TRUNK HIGHWAYS
PROVINCIAL ROADS
RAILWAYS

FIGURE A

STUDY AREA LOCATION MAP

facility. Pictures taken during the site visit serve to illustrate the conditions in and around the active area of disposal. These pictures can be found in Appendix A along with a detailed description of each view.

The disposal site covers an area of approximately 100 metres in length, (east to west) by 63 metres in width, (north to south). A 1.2 meter high wire fence lines the north, east and south sides of the disposal area. In the north-east corner a sign indicates a break in the fence where raw sewage is disposed of. The south side of the fence is broken to allow for disposal of car bodies and bulky metals away from the active dump site.

Access to this area is by a gravel road running north off P.R. 447 approximately .3 kilometres north-east of Napinka. The active dumping area borders on this gravel road.

The active area is a pit formed by a banked ring road surrounding a natural depression. The actual area of disposal is 75 metres in length by 44 metres in width. The banked ring road reaches a maximum elevation of about 2.5 metres at the east end and slopes down to the grade of the access road on the west side. From the information gathered during phase one of this study it was learned that various types of wastes are dumped at this site. General municipal waste, septic tank sludge and household waste are routinely disposed of here.

Burning of the waste at the site was ongoing. There was no evidence of liquid in the actual pit enclosure. No cover, fill material was in evidence at this disposal site. The area designated for sewage disposal, on the north-east side of the site slopes downgrade toward the adjoining gravel pit, which runs along the north side of the disposal area. Figure B details the plan view of the site.

3.2.4 Surficial Geology and Hydrogeology

The surficial geology around the Napinka waste disposal area is directly related to a pro-glacial or glacial environment. Glaciolacustrine clays, silts, sands and some minor gravels were deposited in pro-glacial lakes. These deep basin deposits range from 1 to 20 metres thick and form extensive lake plains. Areas of iceberg scouring are common, with thin layers of alluvial deposits masking some of the underlying glacial debris. Wave washed till and exposed bedrock are also common occurrences in this setting.

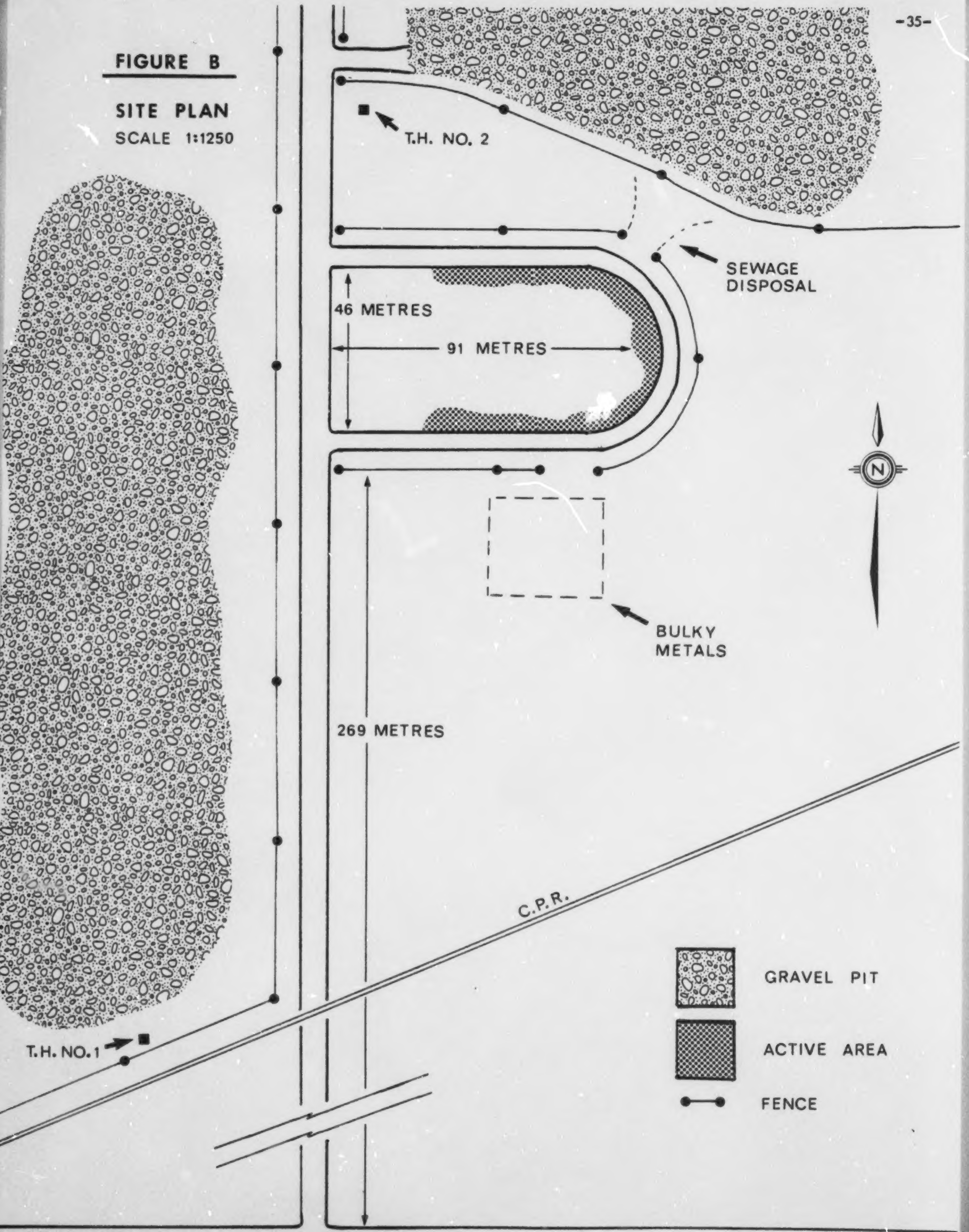
The bedrock in this area is hard, slightly fractured shale, which may contain some water bearing zones. The most common aquifers in the area are the surficial sand and gravel deposits. Most of the domestic water supplies in the Napinka area are drawn from these surficial deposits.

The Water Resources Branch, Department of Natural Resources, Province of Manitoba was requested to complete a groundwater pollution hazard appraisal for the Napinka waste disposal facility. A copy of this appraisal can be found in Appendix B. Basically, the comments made on the appraisal agree with the above general geology. The disposal site is located in an area designated as a high groundwater pollution hazard area because of the sand and gravel aquifers common to this region. A field investigation including test drilling and

FIGURE B

SITE PLAN

SCALE 1:1250


T.H. NO. 2
SEWAGE DISPOSAL
46 METRES
91 METRES
N
BULKY METALS
269 METRES
C.P.R.
T.H. NO.1
GRAVEL PIT
ACTIVE AREA
FENCE

monitoring well installation was indicated in order to confirm subsurface conditions.

On November 12, 1983, two 12 meter deep test holes were drilled at the Napinka waste disposal site using the mud rotary drilling method. Monitoring wells were installed in the two test holes drilled. T.H. #1 was drilled to 12 metres for geologic confirmation. Because of the lower clay formation the 51 mm. I.D. monitoring well at T.H. #1 was set to 4.6 metres, with the last 3 metres slotted and wrapped with fiberglass well screening material. T.H. #2 was drilled to 12 metres for geologic confirmation. In this case the 51 mm. I.D. monitoring well was set to 6.1 metres with the last 3 metres slotted and wrapped with fiberglass well screening material. Geologic logs for the holes drilled can be found in Appendix C. Soil samples taken during the test drilling program have been retained for future reference. The test hole locations can be found on Figure B.

3.2.5 Groundwater Sampling

On November 9, 1983 and again on January 10, 1984, groundwater samples were collected from two residences, two municipal wells and the two installed observation wells. These samples were submitted to the W. M. Ward Technical Services Laboratory for analysis. Bacteriological samples were submitted to the Cadham Provincial Laboratory for testing. The results of these analyses can be found in Appendix D.

Figure C. is an air photo of the study area at a scale of 1:15840. This photo shows the location of the disposal site with respect to the Town of Napinka. The groundwater sampling points established during the field investigation of this waste disposal site have been located on this air photo.

3.2.6 Analytical Results and Conclusions

With regard to the Napinka waste disposal facility and the phase two assessment of the site, some localized environmental damage may have been caused due to leachate from the disposal site getting into the underlying sand and gravel aquifer. Data collected throughout the study indicates, however, that the domestic water supplies sampled are not effected by this particular problem.

Groundwater

Because the site is considered to be in a groundwater pollution hazard area, a test drilling program was established to identify the surficial geologic and hydrogeologic conditions in and around the site.

From information gathered from the two test holes drilled and the exposed sand and gravel in the immediate vacinity, it would seem that the Napinka waste disposal ground is located on a fairly permeable surficial sand and gravel deposit. This deposit thickens from the south-west to the north-east and becomes exposed in the form of a sand and gravel pit on the north side of the waste disposal

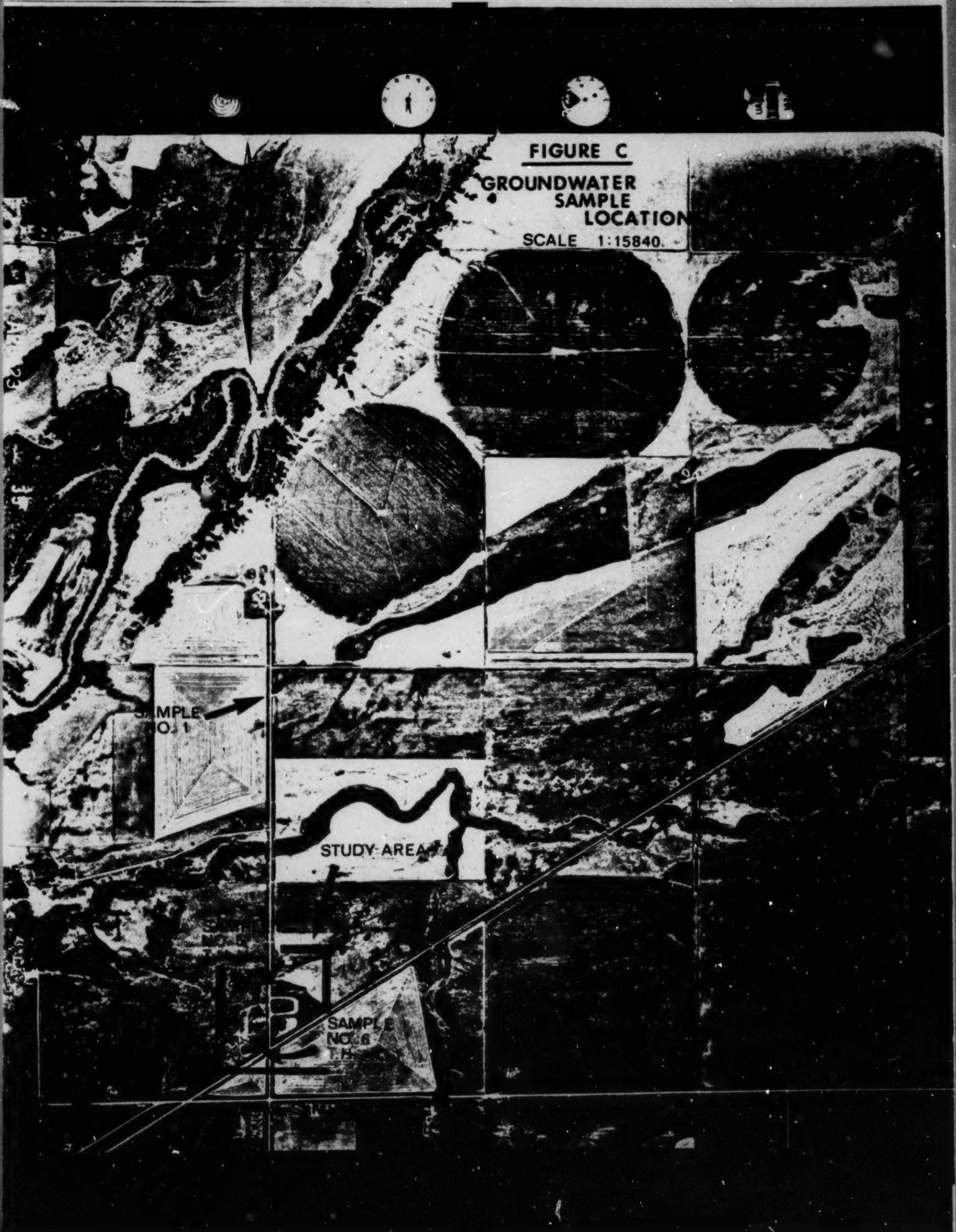


FIGURE C

GROUNDWATER SAMPLE LOCATION

SCALE 1:15840.

SAMPLE NO. 1
STUDY AREA
SAMPLE NO. 6 T.H.

ground. Below the sand and gravel layer is a tight clay till which acts as a barrier to downward leachate migration.

Water quality analyses conducted on the two domestic water supplies, two community wells and the established monitoring wells were compared to the "Guidelines For Canadian Drinking Water Quality" prepared by Health and Welfare Canada in 1978.

Samples #3 and #4, both domestic water supplies and sample #1, a community well north of the disposal facility, can be described in general as of good quality for public consumption. The only parameter of health significance was the nitrate content of sample #3 which was above the maximum acceptable limit. This result can not be attributed to the waste disposal ground.

Results from the monitoring wells, samples #5 and #6 and from the community well south of the disposal area, sample #2, indicate some localized environmental damage to this particular aquifer has been caused by leachate migration from the waste disposal facility. Leachate from the waste and the liquid sewage sludge, is getting into the surficial sand and gravel directly below the disposal site and migrating into the groundwater. It would seem that this pollution is confined to this particular sand and gravel deposit and is not moving into other surficial deposits in the area. This is supported by the water quality analysis of the other sample points tested, which are in close proximity to the Napinka waste disposal grounds, but do not show the same indications of groundwater contamination.

Methane

Methane gas produced through the decomposition of buried domestic wastes can be of concern to buildings located in close proximity to waste disposal sites. Methane gas migration, in this case, is possible through the surficial sand and gravel. However, because the nearest building is about 580 metres south of the waste disposal ground and does not seem to be on the same surficial sand and gravel deposit as the disposal site, methane production if any is not of concern.

It should be noted that explosimeter tests for methane gas were conducted during the test drilling program and at each sampling of the monitoring wells no positive readings were recorded.

Surface Water

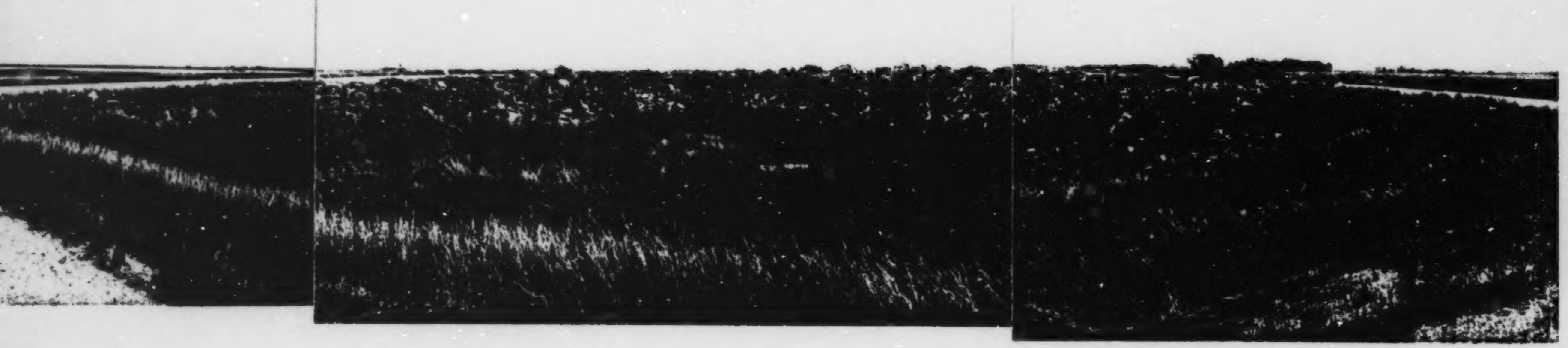
The only observed surface water in close proximity to the Napinka waste disposal facility is a small creek about 552 metres north of the site. Pollution from groundwater migration could be a problem if the groundwater aquifer below the waste disposal ground is hydraulically connected to the creek. The regional groundwater flow is likely in the direction of the creek, but more extensive test drilling and groundwater flow testing would be required to prove the hydraulic connection.

Surficial runoff from the disposal ground to the creek is not of concern because of the distance to the creek and surficial sands and gravels in and around the disposal area which would absorb any runoff water passing through the site.

3.2.7 Recommendations

1) Septic sludge and sewage disposal should be stopped in this area. Sewage liquids will migrate through the surficial sands and gravels and eventually add pollutants to the groundwater aquifer.
2) All bulky metals should be stored in a separate, above grade compound, away from the active disposal area.
3) Consideration should be given to locating a new disposal site in an area where groundwater pollution will not occur. A site should be selected with at least 1.5 metres of impermeable clay like material between the bottom of the active area and any underlying groundwater aquifer.
4) Refer to Manitoba Regulation 208/76 under the Clean Environment Act for further clarification of these recommendations and other waste disposal ground opperating procedures.

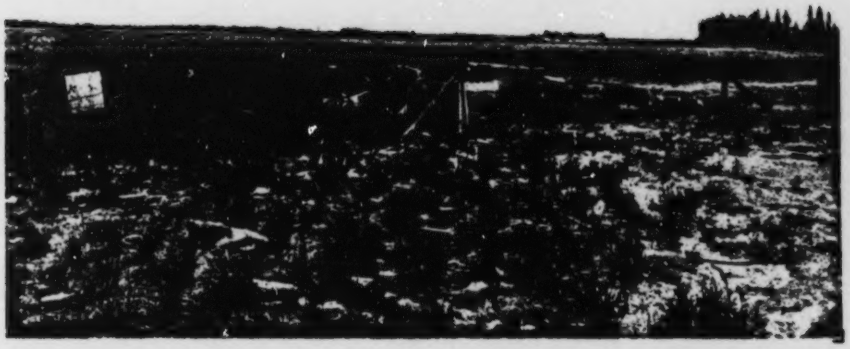
APPENDIX A



Date: August 18, 1983 Location: Napinka Waste Disposal Ground

Orientation: Panorama, from left to right = looking from north-east to south-east

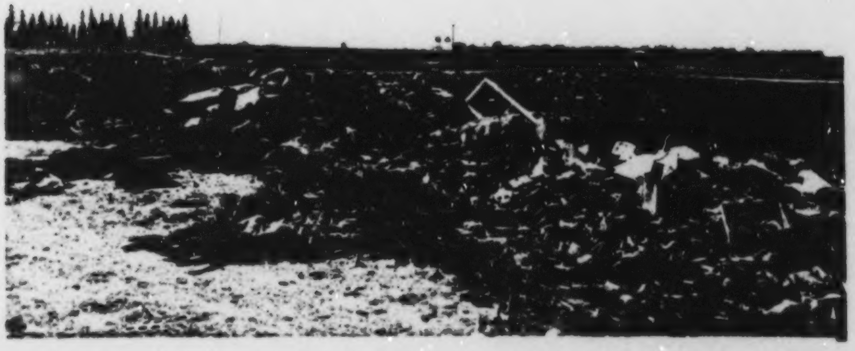
Comments: Picture of the working face of the disposal area. The surficial soil in front of the working face is very sandy, and the vegitation is fairly thin in some places.



Date: August 18, 1983 Location: Napinka Waste Disposal Ground

Orientation: Taken from the south-east corner of the site looking south.

Comments: Metals disposal area. Note that this area is outside the fenced in portion of the waste disposal ground.



Date: August 18, 1983 Location: Napinka Waste Disposal Ground

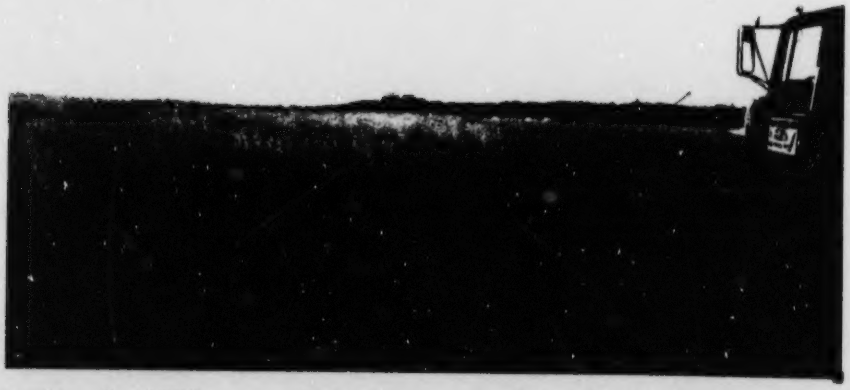
Orientation: Taken from the east side of the site looking south-west

Comments: Notice that the waste is disposed of in the depression created by the ring road around the disposal area.

Date: August 18, 1983 Location: Napinka Waste Disposal Ground

Orientation: Taken from the north-east corner of the site looking north.

Comments: Sewage disposal area. Raw sewage dumped here can run downhill to the gravel pit located in the upper left of the picture just past the fence line.



Date: November 9, 1983 Location: Napinka Waste Disposal Ground

Orientation: Slightly north of the site road looking east.

Comments: Picture shows sewage truck discharging contents into sewage disposal area.

Date: November 9, 1983 Location: Napinka Waste Disposal Ground

Orientation: South-west of the waste disposal ground looking east.

Comments: Test hole #1 with monitoring well in place.

Date: November 9, 1983 Location: Napinka Waste Disposal Ground

Orientation: Off north-west corner of disposal area looking east.

Comments: Drilling of test hole #2. A monitoring well was installed at this location.

APPENDIX B

FILE NO. 5.7.4.2.

WATER RESOURCES BRANCH

GROUNDWATER POLLUTION HAZARD APPRAISAL

POTENTIAL SOURCE OF POLLUTION	Waste Disposal Ground
LOCATION OF SOURCE	SW29-4-25W
OWNER OF SOURCE	R.M. of Brenda, Napinka

GEOLOGICAL CONDITIONS	SURFICIAL DEPOSITS	From 1 m to 10 m of sand and gravel underlain by glacial till. The total thickness of the surficial deposits is up to 20 m.
	BEDROCK	Shale.

GROUNDWATER CONDITIONS	AQUIFERS	The sand and gravel deposits form the most common aquifers in the area. The shale bedrock may contain some water bearing zones.
	WELLS	Nearly all the wells reported in this area draw water from the sand and gravel aquifers.

POLLUTION HAZARD

Because shallow sand and gravel aquifers are common, this is a high groundwater pollution hazard area.

COMMENTS

BY: M. Rutulis, P. Eng.
GROUNDWATER GEOLOGIST

DATE: Dec. 7, 1983

APPENDIX C

GEOLOGIC LOG

Test Hole Identification: Napinka, T.H. #1

Location: Napinka, Manitoba. R.M. of Brenda.

Legal Description: SE-30-4-25W

Date: November 9, 1983.

Time: 1:45 P.M. to 3:15 P.M.

Total Depth: 12 Metres

Type Of Casing: Series 160 plastic

Type Of Screen: Slotted, Fiberglass wrap

Depth	Description
0 to 1.5 m.	Coarse brown sand and gravel.
1.5 to 3.0 m.	Grading into brown clay till, about 30% coarse sand and gravel.
3.0 to 4.6 m.	Gray clay till, very little sand and or gravel.
4.6 to 6.1 m.	Gray clay till.
6.1 to 7.6 m.	Gray clay till, minor amounts of sand and stones.
7.6 to 12.2 m.	Gray clay till, clay very tight, some stone

GEOLOGIC LOG

Test Hole Identification: Napinka, T.H. #2

Location: Napinka, Manitoba. R.M. of Brenda

Legal Description: SW-29-4-25W

Date: November 9, 1983

Time: 3:45 P.M. to 5:15 P.M.

Total Depth: 9.1 Metres

Type Of Casing: Series 160 plastic

Type Of Screen: Slotted, Fiberglass wrap

Depth	Description
0 to 1.5 m.	Fine to coarse gravel.
1.5 to 6.1 m.	Medium to coarse gravel.
6.1 to 7.6 m.	Coarse sand clay till, 5 to 10% clay.
7.6 to 9.1 m.	Gray clay till, very tight, small amounts of coarse sand and gravel.

APPENDIX D

Water Quality Analysis

Project: Phase II Landfill Study

Location: Napinka, R.M. of Brenda, NW-29-4-25W

Sample #: 1

Date: Result A; November 9, 1983 Result B; January 11, 1984

Parameter	Result A	Result B	Measured Unit
Conductivity	595.00	553.00	umho/cm
Residue Total	370.00	360.00	mg/l
Residue Filterable	370.00	360.00	mg/l
Residue Non Filterable	L 5.00	L 5.00	mg/l
pH	7.55	7.70	units
Alkalinity Total (CaCO3)	290.00	274.00	mg/l
Alkalinity (HCO3)	354.00	334.00	mg/l
Alkalinity (CO3)	0.00	0.00	mg/l
Alkalinity (OH)	0.00	0.00	mg/l
Arsenic, As	L 0.001	L 0.001	mg/l
Cadmium, Cd	L 0.001	L 0.001	mg/l
Copper, Cu	0.01	0.01	mg/l
Lead, Pb	L 0.005	L 0.005	mg/l
Zinc, Zn	0.03	0.12	mg/l
Chromium, Cr	L 0.005	L 0.005	mg/l
Calcium, Ca	55.60	52.50	mg/l
Magnesium, Mg	36.70	32.40	mg/l
Hardness (CaCO3)	290.00	264.00	mg/l
Manganese, Mn	0.14	0.13	mg/l
Iron, Fe	0.37	1.36	mg/l
Sodium, Na	34.80	29.70	mg/l
Color	-	-	units
Turbidity	0.90	3.00	NTU
Cyanide, CN	-	L 0.02	mg/l
NO3-NO2-N	0.16	0.04	mg/l
Chloride, Cl	6.00	5.00	mg/l
Sulphate, SO4	31.00	29.00	mg/l
Coliform Group	-	L 1.00	per 100 ml
Fecal Coliform	-	L 1.00	per 100 ml

L = Less Than

G = Greater Than

Water Quality Analysis

Project: Phase II Landfill Study

Location: Napinka, R.M. of Brenda, NE-19-4-25W

Sample #: 2

Date: Result A; November 9, 1983 Result B; January 11, 1984

Parameter	Result A	Result B	Measured Unit
Conductivity	959.00	949.00	umho/cm
Residue Total	610.00	630.00	mg/l
Residue Filterable	600.00	630.00	mg/l
Residue Non Filterable	7.00	L 5.00	mg/l
pH	8.20	8.10	units
Alkalinity Total (CaCO3)	332.00	338.00	mg/l
Alkalinity (HCO3)	405.00	412.00	mg/l
Alkalinity (CO3)	0.00	0.00	mg/l
Alkalinity (OH)	0.00	0.00	mg/l
Arsenic, As	L 0.001	L 0.001	mg/l
Cadmium, Cd	0.001	0.001	mg/l
Copper, Cu	0.09	0.03	mg/l
Lead, Pb	L 0.005	L 0.005	mg/l
Zinc, Zn	5.65	4.71	mg/l
Chromium, Cr	0.006	0.009	mg/l
Calcium, Ca	80.20	74.80	mg/l
Magnesium, Mg	66.00	61.00	mg/l
Hardness (CaCO3)	472.00	438.00	mg/l
Manganese, Mn	0.17	0.14	mg/l
Iron, Fe	4.34	4.89	mg/l
Sodium, Na	52.50	45.50	mg/l
Color	-	-	units
Turbidity	2.50	6.00	NTU
Cyanide, CN	-	L 0.02	mg/l
NO3-NO2-N	9.20	8.40	mg/l
Chloride, Cl	44.00	44.00	mg/l
Sulphate, SO4	91.00	96.00	mg/l
Coliform Group	-	L 1.00	per 100 ml
Fecal Coliform	-	L 1.00	per 100 ml

L = Less Than

G = Greater Than

Water Quality Analysis

Project: Phase II Landfill Study

Location: Napinka, R.M. of Brenda, SW-30-4-25W

Sample #: 3

Date: Result A; November 9,1983 Result B; N/A

Parameter	Result A	Result B	Measured Unit
Conductivity	1260.00		umho/cm
Residue Total	870.00		mg/l
Residue Filterable	870.00		mg/l
Residue Non Filterable	L 5.00		mg/l
pH	7.20		units
Alkalinity Total (CaCO3)	338.00		mg/l
Alkalinity (HCO3)	412.00		mg/l
Alkalinity (CO3)	0.00		mg/l
Alkalinity (OH)	0.00		mg/l
Arsenic, As	L 0.001		mg/l
Cadmium, Cd	L 0.001		mg/l
Copper, Cu	0.13		mg/l
Lead, Pb	L 0.005		mg/l
Zinc, Zn	0.06		mg/l
Chromium, Cr	L 0.005		mg/l
Calcium, Ca	155.00		mg/l
Magnesium, Mg	61.70		mg/l
Hardness (CaCO3)	641.00		mg/l
Manganese, Mn	L 0.01		mg/l
Iron, Fe	0.04		mg/l
Sodium, Na	37.00		mg/l
Color	-		units
Turbidity	0.35		NTU
Cyanide, CN	-		mg/l
NO3-NO2-N	35.00		mg/l
Chloride, Cl	66.00		mg/l
Sulphate, SO4	115.00		mg/l
Coliform Group	-		per 100 ml
Fecal Coliform	-		per 100 ml

L = Less Than

G = Greater Than

Water Quality Analysis

Project: Phase II Landfill Study

Location: Napinka, R.M. of Brenda, NW-20-4-25W

Sample #: 4

Date: Result A; November 9, 1983 Result B; January 11,1984

Parameter	Result A	Result B	Measured Unit
Conductivity	1610.00	1390.00	umho/cm
Residue Total	1050.00	930.00	mg/l
Residue Filterable	1050.00	930.00	mg/l
Residue Non Filterable	L 5.00	L 5.00	mg/l
pH	7.70	7.65	units
Alkalinity Total (CaCO3)	488.00	414.00	mg/l
Alkalinity (HCO3)	595.00	505.00	mg/l
Alkalinity (CO3)	0.00	0.00	mg/l
Alkalinity (OH)	0.00	0.00	mg/l
Arsenic, As	0.004	0.003	mg/l
Cadmium, Cd	L 0.001	L 0.001	mg/l
Copper, Cu	0.12	0.08	mg/l
Lead, Pb	0.005	L 0.005	mg/l
Zinc, Zn	0.10	0.04	mg/l
Chromium, Cr	L 0.005	L 0.005	mg/l
Calcium, Ca	125.00	109.00	mg/l
Magnesium, Mg	75.00	64.00	mg/l
Hardness (CaCO3)	621.00	536.00	mg/l
Manganese, Mn	L 0.02	L 0.02	mg/l
Iron, Fe	L 0.02	L 0.02	mg/l
Sodium, Na	155.00	117.00	mg/l
Color	-	-	units
Turbidity	0.40	0.25	NTU
Cyanide, CN	-	L 0.02	mg/l
NO3-NO2-N	33.00	17.2	mg/l
Chloride, Cl	99.00	94.00	mg/l
Sulphate, SO4	135.00	140.00	mg/l
Coliform Group	-	L 1.00	per 100 ml
Fecal Coliform	-	L 1.00	per 100 ml

L = Less Than

G = Greater Than

Water Quality Analysis

Project: Phase II Landfill Study

Location: Napinka, R.M. of Brenda, SW-29-4-25W

Sample #: 5

Date: Result A; November 9,1983 Result B; January 11, 1984

Parameter	Result A	Result B	Measured Unit
Conductivity	2070.00	1770.00	umho/cm
Residue Total	1680.00	-	mg/l
Residue Filterable	1570.00	1320.00	mg/l
Residue Non Filterable	105.00	-	mg/l
pH	8.20	7.65	units
Alkalinity Total (CaCO3)	364.00	374.00	mg/l
Alkalinity (HCO3)	444.00	456.00	mg/l
Alkalinity (CO3)	0.00	0.00	mg/l
Alkalinity (OH)	0.00	0.00	mg/l
Arsenic, As	L 0.001	0.001	mg/l
Cadmium, Cd	0.001	L 0.001	mg/l
Copper, Cu	0.13	0.22	mg/l
Lead, Pb	L 0.005	L 0.005	mg/l
Zinc, Zn	0.12	0.09	mg/l
Chromium, Cr	0.022	0.006	mg/l
Calcium, Ca	118.00	114.00	mg/l
Magnesium, Mg	65.80	67.60	mg/l
Hardness (CaCO3)	566.00	563.00	mg/l
Manganese, Mn	0.28	L 0.02	mg/l
Iron, Fe	1.00	0.11	mg/l
Sodium, Na	290.00	249.00	mg/l
Color	-	-	units
Turbidity	75.00	-	NTU
Cyanide, CN	-	-	mg/l
NO3-NO2-N	1.20	1.28	mg/l
Chloride, Cl	53.00	45.00	mg/l
Sulphate, SO4	535.00	535.00	mg/l
Coliform Group	-	-	per 100 ml
Fecal Coliform	-	L 1.00	per 100 ml

L = Less Than

G = Greater Than

Water Quality Analysis

Project: Phase II Landfill Study

Location: Napinka, R.M. of Brenda, SE-30-4-25W

Sample #: 6

Date: Result A; N/A Result B; January 11, 1984

Parameter	Result A	Result B	Measured Unit
Conductivity		1110.00	umho/cm
Residue Total		-	mg/l
Residue Filterable		830.00	mg/l
Residue Non Filterable		-	mg/l
pH		7.75	units
Alkalinity Total (CaCO3)		406.00	mg/l
Alkalinity (HCO3)		495.00	mg/l
Alkalinity (CO3)		0.00	mg/l
Alkalinity (OH)		0.00	mg/l
Arsenic, As		0.001	mg/l
Cadmium, Cd		L 0.001	mg/l
Copper, Cu		0.05	mg/l
Lead, Pb		L 0.005	mg/l
Zinc, Zn		0.04	mg/l
Chromium, Cr		0.006	mg/l
Calcium, Ca		108.00	mg/l
Magnesium, Mg		48.40	mg/l
Hardness (CaCO3)		469.00	mg/l
Manganese, Mn		1.00	mg/l
Iron, Fe		0.84	mg/l
Sodium, Na		102.00	mg/l
Color		-	units
Turbidity		-	NTU
Cyanide, CN		-	mg/l
NO3-NO2-N		0.10	mg/l
Chloride, Cl		38.00	mg/l
Sulphate, SO4		165.00	mg/l
Coliform Group		-	per 100 ml
Fecal Coliform		-	per 100 ml

L = Less Than

G = Greater Than

3.3

RIVERS WASTE DISPOSAL GROUND

SW-25-12-21W

R.M. OF DALY #1

3.3 Rivers Waste Disposal Ground

3.3.1 Location

The Town of Rivers, Manitoba is located within the Rural Municipality of Daly, approximately 215 kilometres west of Winnipeg along P.T.H. 25. The waste disposal area is located about .8 kilometres north-east of the town and the legal discription is SW-25-12-21W.

Figure A is a Rural Municipality Map locating the study area and the Town of Rivers within the Rural Municipality of Daly.

3.3.2 Physiography

This region is dominated by flat prairie dotted with small areas of depression often containing marsh or small swamp like lakes. The area is characteristic of flat glacial lake deposition. The topography slopes gently southward toward the Little Saskatchewan River. Surficial sand and gravel deposits are numerous between the Rivers waste disposal ground and the Little Saskatchewan River.

Surficial drainage for the area is from north to south toward the river. In the immediate vacinity of the waste disposal ground, drainage is to an intermittent creek. This creek channel has been encroached upon by the waste facility. The creek bed is generally swampy but during spring thaw or periods of extreme rainfall the creek may flow freely, eventually reaching the Little Saskatchewan River.

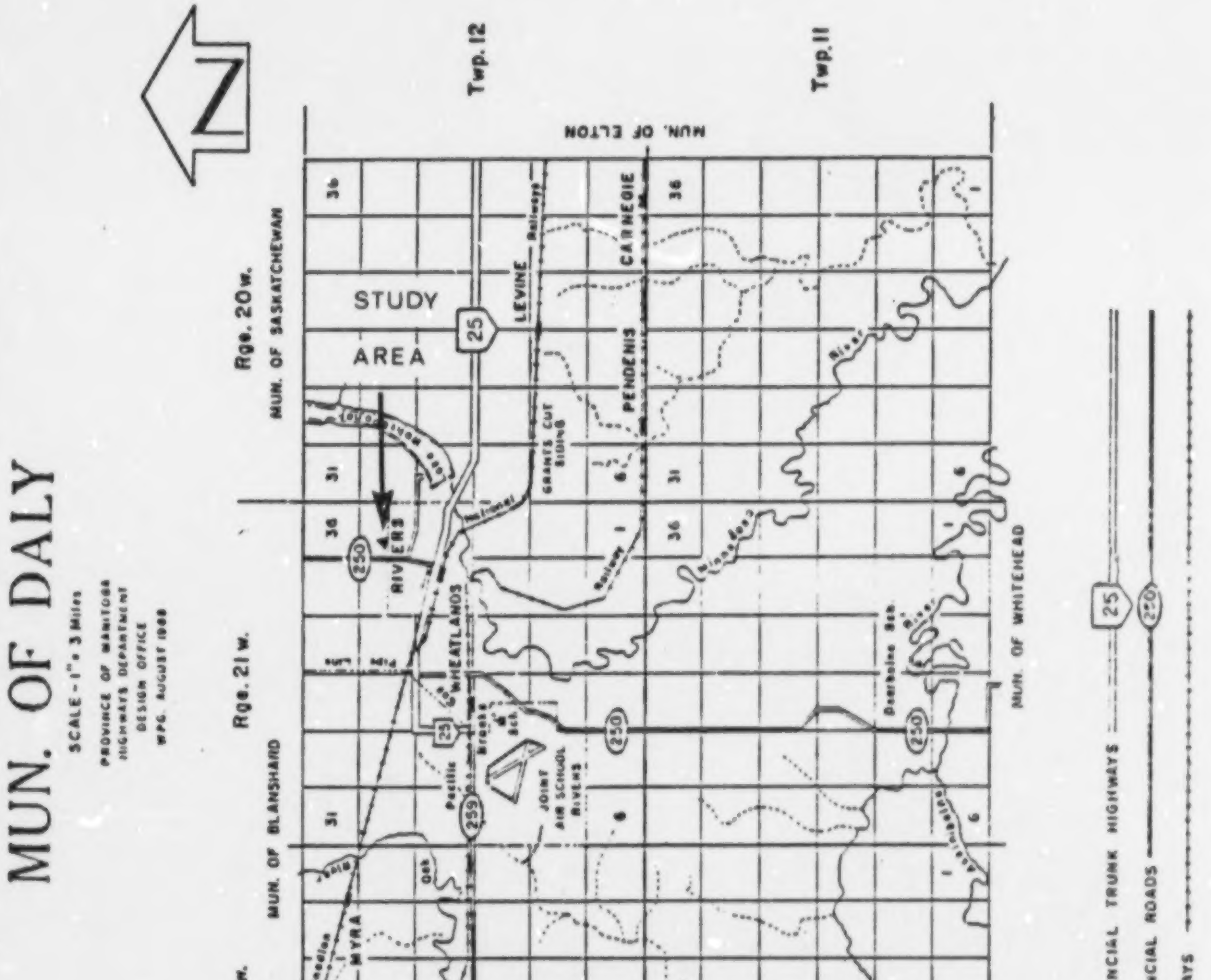

MUN. OF DALY
SCALE - 1" = 3 Miles
PROVINCE OF MANITOBA
HIGHWAYS DEPARTMENT
DESIGN OFFICE
WPG. AUGUST 1968
N
Rge. 22 w.
Rge. 21 w.
Rge. 20 w.
Twp. 12
Twp. 11
MUN. OF BLANSHARD
MUN. OF SASKATCHEWAN
MUN. OF ELTON
MUN. OF WOODWORTH
MUN. OF WHITEHEAD
STUDY AREA
RIVERS
WHEATLANDS
LEVINE
CARNEGIE
PENDENNIS
GRANTS CUT SIDING
MYRA
BRADWARDINE
JOINT AIR SCHOOL RIVERS
25
250
259
354
PROVINCIAL TRUNK HIGHWAYS
PROVINCIAL ROADS
RAILWAYS

FIGURE A

STUDY AREA
LOCATION MAP

3.3.3 Site Conditions

During the site visit on August 19, 1983, a number of observations were made with regard to the Rivers waste disposal facility. Pictures taken during the site visit serve to illustrate the conditions in and around the active area of disposal. These pictures can be found in Appendix A, along with a detailed description of each view.

The disposal site covers an area of approximately 73 metres in length, (north-east to south-west) by 61 metres in width, (north-west to south-east). The disposal area is fenced in on the north, east and south-east by a 1 metre high, wire enclosure. Access to the area is by a gravel road running in a north-easterly direction off P.R. 250. Many signs along the access road and at the active disposal area give instructions on disposal procedures at this particular site.

The active disposal area is along the west face of the disposal site. Dumping takes place on the leading edge, the waste is burnt and pushed over the side into what used to be a creek channel. The waste is then covered with sand and gravel taken from the exposed surficial deposits located just outside the entrance to the active area. The disposal area rises approximately 3 metres above the creek basin. Two tiers of waste have been burried in the channel. The active face has moved from east to west along the channel and will eventually fill the valley to the grade of the surrounding prairie.

The vegetation growth along the creek channel can be described as marsh type with a fairly high moisture content in the surrounding base matt. The eastern extent of the waste disposal area now supports a heavy grass growth.

From information gathered during Phase I of this study it was learned that various types of household and municipal wastes are deposited at this disposal facility. While at the site it was observed that pesticide containers had been discarded in the active disposal area.

A separate area has been designated for bulky metals. This area is clearly marked with large signs, and is located in a gravel pit south-west of the waste disposal ground. This gravel pit can be found on the south-east corner of the junction between P.R. 250 and the waste disposal ground access road.

There was no noticable evidence of septic sludge or sewage waste disposal at the site during the field inspection. Figure B details the plan view of the site.

3.3.4 Surficial Geology and Hydrogeology

In general the surficial geology of the Rivers area can be directly related to a pro-glacial or glacial environment. Glacioluvial deposits 1 to 100 metres thick are common for this area. Clay, silt, sand and some minor amounts of gravel were deposited in an ice marginal environment. There are some indications of outwash deposition and glacial valley fill in the vacinity of the disposal site. Some fairly extensive sand and gravel deposits are found

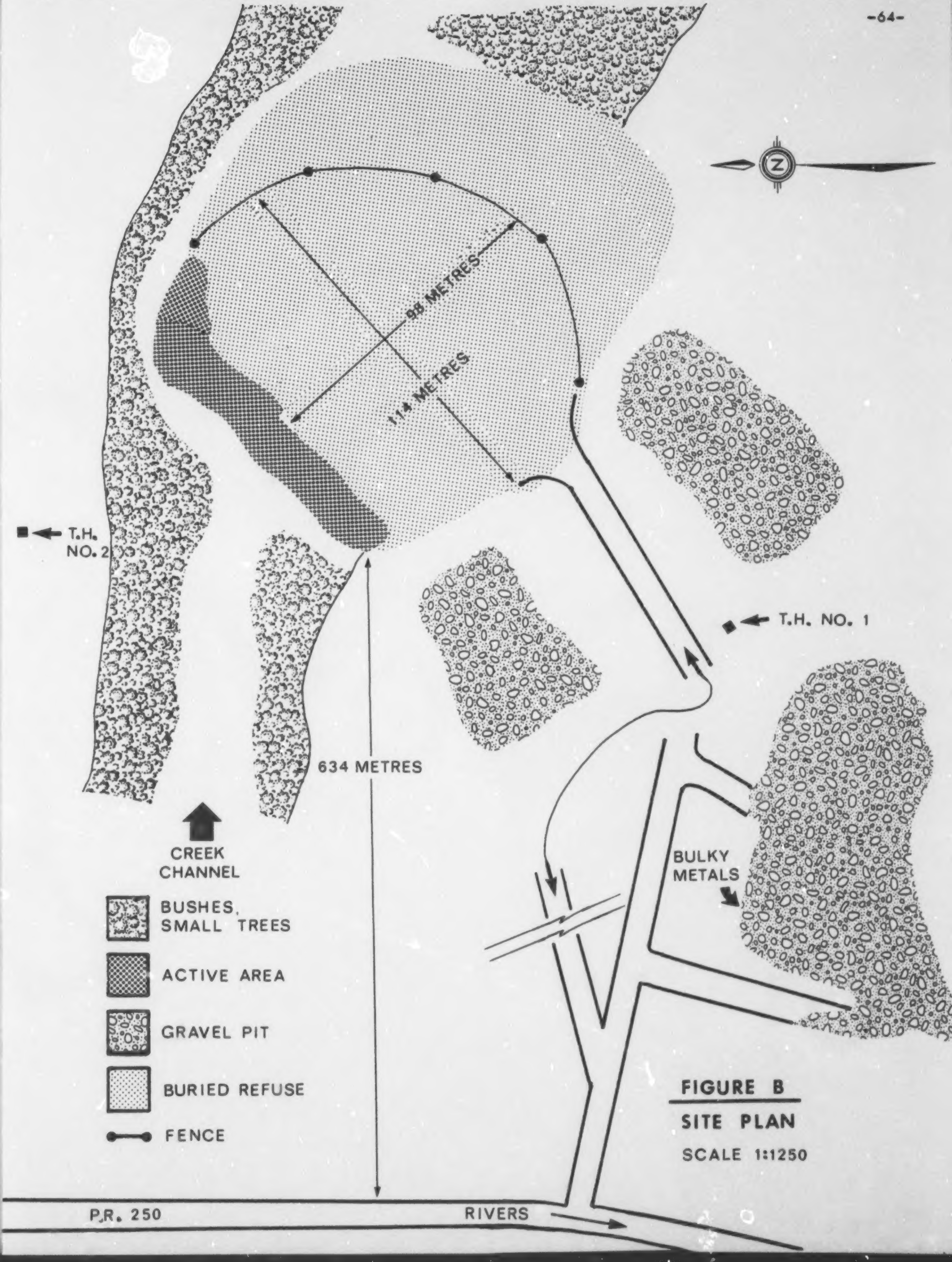

Z
98 METRES
114 METRES
T.H. NO. 2
T.H. NO. 1
634 METRES
CREEK CHANNEL
BULKY METALS
P.R. 250
RIVERS
BUSHES, SMALL TREES
ACTIVE AREA
GRAVEL PIT
BURIED REFUSE
FENCE

FIGURE B

SITE PLAN

SCALE 1:1250

adjoining the waste disposal area approximately 576 metres south of the site.

The bedrock in the area is commonly hard, unfractured shale. Groundwater movement in the shale is restricted due to the lack of fractures which normally make up the typical shale aquifer. Groundwater aquifers in this area are found in the surficial sand and gravel deposits and in isolated pockets of sand within the till. Most of the domestic water supplies in the Rivers area are drawn from the surficial sand and gravel aquifer.

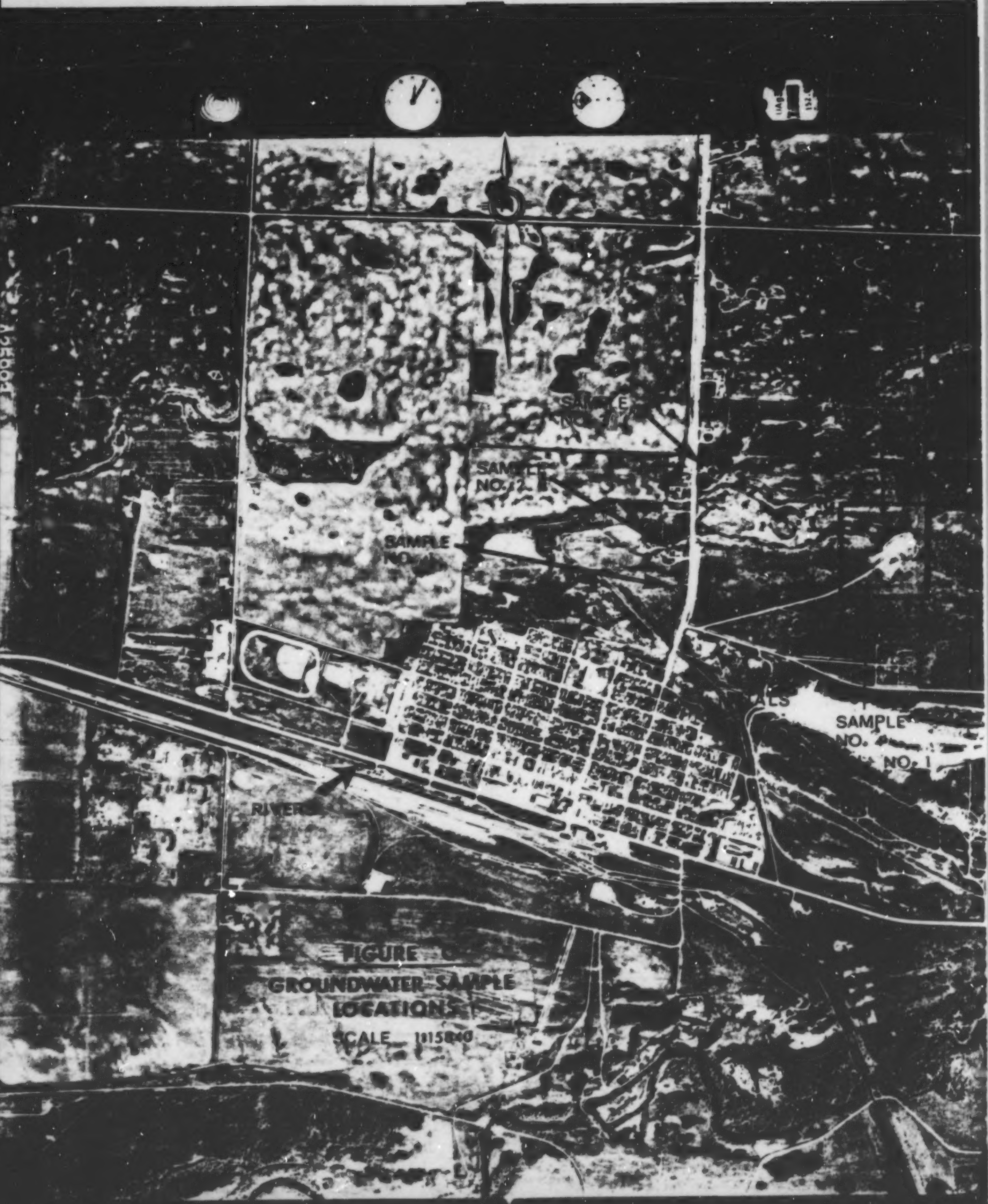
The Water Resources Branch, Department of Natural Resources, Province of Manitoba was requested to complete a groundwater pollution hazard appraisal for the Rivers waste disposal facility. A copy of this appraisal can be found in Appendix B. Basically the comments made on the appraisal agree with the above general geology. This disposal site is located in an area designated as a high groundwater pollution hazard area because of the surficial water bearing sand and gravel deposits. A field investigation including test drilling and monitoring well installation was formulated in order to confirm subsurface conditions.

On November 1, 1983, two 9 metre deep test holes were drilled at the Rivers waste disposal site using the mud rotary drilling method. Monitoring wells were installed in the two test holes drilled. T.H. #1 was drilled to 9 metres for geologic confirmation. Because of the lower clay till formation, the 55 mm. I.D. monitoring well at T.H. #1 was set to 7.6 metres, with the last 1.5 metres slotted and wrapped with fiberglass well screening material. T.H. #2 was drilled to 9 metres for geologic confirmation. In this case the 51 mm. I.D. monitoring well was set to 8 metres with the last 1.5 metres slotted and wrapped with fiberglass well screening material. Geologic logs for the holes drilled can be found in Appendix C. Soil samples taken during the test drilling program have been retained for future reference. Test hole locations can be found on Figure B.

3.3.5 Groundwater Sampling

On November 1, 1983, and again on January 12, 1984, groundwater samples were collected from 3 residences west of the disposal facility and the two installed monitoring wells. These samples were submitted to the W. M. Ward Technical Services Laboratory for analysis. Bacteriological samples were submitted to the Cadham Provincial Laboratory for testing. The results of these analyses can be found in Appendix D.

Figure C is an air photo of the study area at a scale of 1:15840. This photo shows the location of the disposal site with respect to the town of Rivers. The groundwater sampling points established during the field investigation of this waste disposal site have been located on this air photo.



SAMPLE
NO.
SAMPLE
NO. 2
SAMPLE
NO.
ALS
SAMPLE
NO. 4
NO. 1
RIVER

FIGURE

GROUNDWATER SAMPLE LOCATIONS

SCALE 1:15840

3.3.6 Analytical Results and Conclusions

With regard to the Rivers waste disposal facility and the phase two assessment of the site, some localized environmental damage may have been caused due to leachate from the disposal site getting into the underlying sand and gravel aquifer. Data collected throughout the study indicates however, that the domestic water supplies sampled are not effected by this particular problem.

Groundwater

Because the disposal site is considered to be in a groundwater pollution hazard area, a test drilling program was established to identify the surficial geologic and hydrogeologic conditions in and around the site.

From information gathered from the two test holes drilled, and the exposed sand and gravel in the immediate vacinity, it would seem that the Rivers waste disposal ground is located on a fairly permeable sand and gravel deposit. This sand and gravel becomes exposed in the from of a pit on the south side of the waste facility. Below the sand and gravel is a tight clay till which acts as a barrier to downward leachate migration.

Water quality analyses conducted on the three domestic water supplies and the two established monitoring wells were compared to the "Guidelines for Canadian Drinking Water Quality" prepared by Health and Welfare Canada in 1978. Samples #1, #2 and #3 are all domestic groundwater supplies located west of the disposal site. Sample #5, (T.H. #2) is located 75 metres north of the disposal facility. The groundwater sampled from these sources can be described in general as good quality for public consumption. The only parameter of health significance was the nitrate count of sample #3 which was above the maximum acceptable limit when sampled November 1, 1983. This result cannot be attributed to the Rivers waste disposal ground.

Results from sample #4, (T.H. #1) located approximately 75 metres south of the disposal area, indicates that some environmental damage has been caused by leachate migration from the waste disposal ground. Because sample #4 shows signs of groundwater contamination and sample #5 is of good quality with respect to the parameters tested, migration of leachate and the direction of groundwater flow would seem to be south, in the direction of the Little Saskatchewan River.

Methane

Methane gas produced through the decomposition of buried domestic waste can be of concern to buildings located in close proximity to waste disposal sites. At this site the migration of methane gas through the highly permeable surficial sands and gravels is possible. In this case however, because of the distance to the nearest building, about 627 metres, methane gas production, if any, is not a concern.

It should be noted that exposimeter tests for methane gas were conducted during the test drilling and at each sampling of the monitoring wells and no positive readings were recorded.

Surface Water

The Little Saskatchewan River is located 1.6 kilometres south of the Rivers waste disposal ground. Pollution of the river due to either groundwater migration or surficial runoff is possible, however not likely, because of the distance between the disposal area and the river. Further testing would be required in order to determine surface water pollution from either sources.

The Rivers waste disposal ground does straddle what can be described as an intermittent creek channel. The creek itself would only flow during periods of heavy runoff or precipitation. Direct deposit of waste in the creek channel has blocked the water course. Any water flow would have to travel under or around the waste eventually reaching the Little Saskatchewan River.

3.3.7 Recommendations

1) All pesticide containers should be drained, crushed and stored in a separate area away from the active disposal area. Crushing the containers reduces the size of storage area required to hold the empty cans. Draining the cans reduces the risk of environmental pollution from pesticide residues. All drainings should be collected and disposed of in an approved manner.
2) Consideration should be given to locating a new waste disposal site in an area where groundwater and surface water pollution will not occur. A site should be located in an area with at

least 1.5 metres of impermeable clay like material between the bottom of the active disposal area and any underlying groundwater aquifer. When selecting a site, natural depressions such as creek channels and gravel pits should not be considered because of the possible hydraulic connection to both groundwater aquifers and large surface water bodies.

3) Refer to Manitoba Regulation 208/76 under the Clean Environment Act for further clarification of these recommendations and other waste disposal ground operating procedures.

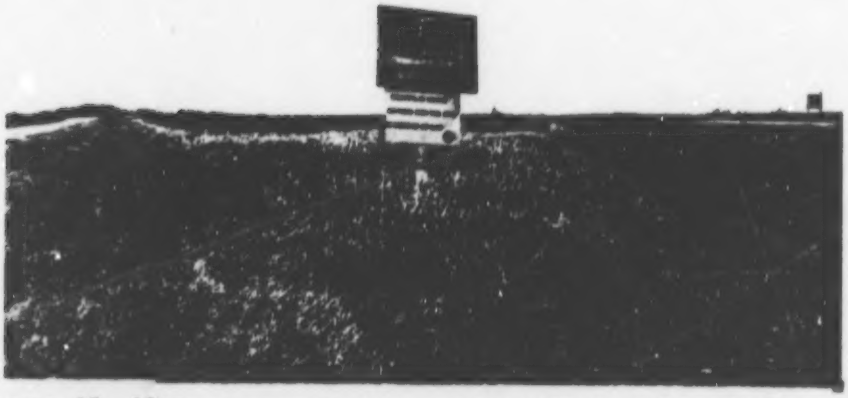
APPENDIX A

RIVERS
FOR
RE-USABLE METALS

Date: August 19, 1983 Location: Rivers Waste Disposal Ground

Orientation: Picture taken from access road looking south

Comments: Rivers metals compound south-west of disposal grounds. Appears to be an old sand and gravel excavation.



Date: August 19, 1983 Location: Rivers Waste Disposal Ground

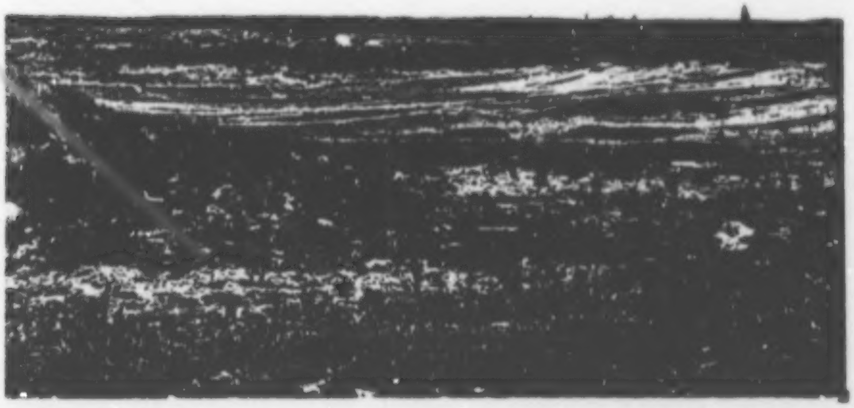
Orientation: Taken from access road looking east.

Comments: Directions for disposal practices used at the Rivers disposal area. Sign found about 100 meters up the access road off highway 250. Metals compound sign, center right of photograph.

Date: August 19, 1983 Location: Rivers Waste Disposal Ground

Orientation: Taken from site entrance looking west.

Comments: Surficial sand and gravel deposit found south-west of the active disposal area. This material may be used as fill for the disposal ground.



Date: August 19, 1983 Location: Rivers Waste Disposal Ground

Orientation: Taken from site entrance looking south-east.

Comments: Surficial sand and gravel deposit found south-east of the active disposal area. Surficial conditions for this entire region are very much the same as this.

DUMP
ALL
GARBAGE
OVER
EDGE

Date: August 19, 1983 Location: Rivers Waste Disposal Ground

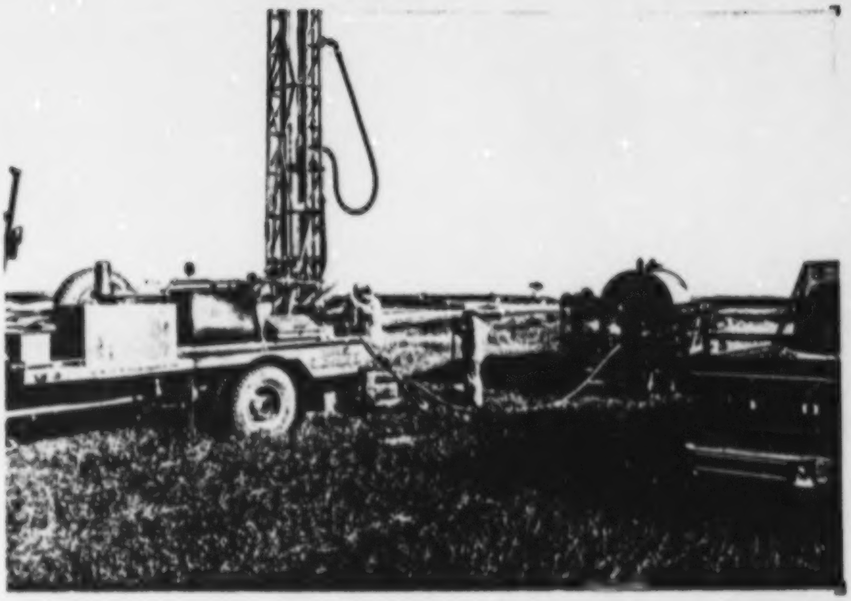
Orientation: Taken from the north side of the site looking north.

Comments: Signs along fence indicating dumping practices. Note that the stream channel interrupted by this disposal site continues on it's way approximately 15 meters north of these signs.

Date: August 19, 1983 Location: Rivers Waste Disposal Ground

Orientation: Taken on the east side of the site looking east.

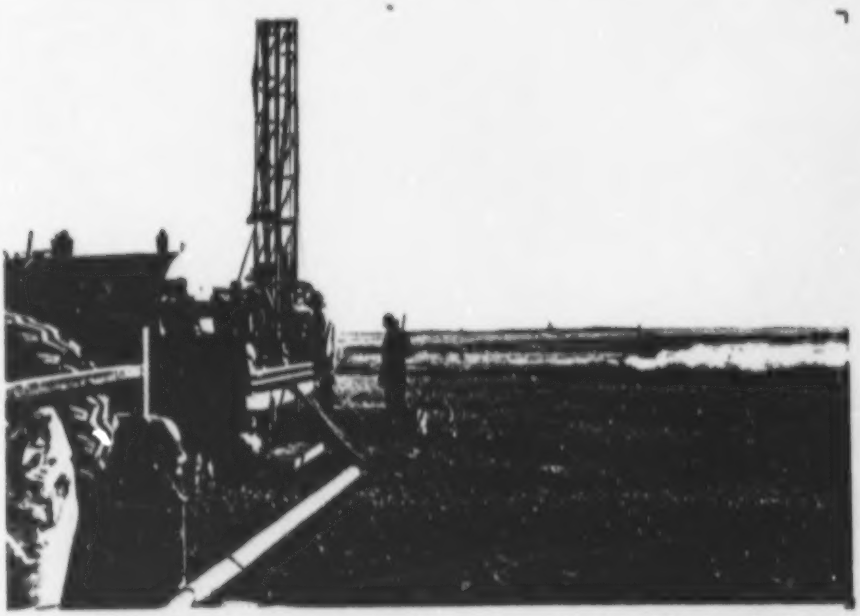
Comments: This view shows the stream channel as it runs into the working face of the disposal ground. The vegitation in this channel is a marsh or swamp type of grass indicative of a moist environment.



Date: November 1, 1983 Location: Rivers Waste Disposal Ground

Orientation: East side of access road looking north-west.

Comments: Drilling of test hole #1. Rivers disposal area can be seen in center background. A monitoring well was installed at this site.



Date: November 1, 1983 Location: Rivers Waste Disposal Ground

Orientation: North of stream channel looking south-east.

Comments: Drilling of test hole #2. Rivers disposal area can be seen in center background. A monitoring well was installed at this site.

Date: August 19, 1983 Location: Rivers Waste Disposal Ground.

Orientation: Panorama, looking from left to right = from north to east.

Comments: Working face on the west side of the disposal area. Note direct disposal in stream channel.

APPENDIX B

FILE No. 5.7.4.2.

WATER RESOURCES BRANCH

GROUNDWATER POLLUTION HAZARD APPRAISAL

POTENTIAL SOURCE OF POLLUTION	Waste Disposal Ground
LOCATION OF SOURCE	SW25-12-21W
OWNER OF SOURCE	R.M. of Daly, Rivers

GEOLOGICAL CONDITIONS	SURFICIAL DEPOSITS	Up to 10 m of sand and gravel underlain by glacial till with a few pockets of sand and gravel. The total thickness of the surficial deposits is more than 90 m.
	BEDROCK	Shale.

GROUNDWATER CONDITIONS	AQUIFERS	Sand and gravel aquifers are formed by the surface sand and gravel and the pockets of sand and gravel in the till. Groundwater movement in the surface sand and gravel likely is southerly towards Little Saskatchewan River.
	WELLS	Most wells reported in the area draw water from the surface sand and gravel aquifers. A few wells have been completed in the sand and gravel within the till.

POLLUTION HAZARD

Because at some locations the surface sand and gravel is water bearing, groundwater pollution hazard exists in some parts of this and adjacent quarter sections.

COMMENTS

BY: M. Rutulis, P. Eng.
GROUNDWATER GEOLOGIST

DATE: Dec. 7, 1983

APPENDIX C

GEOLOGIC LOG

Test Hole Identification: Rivers, T.H. #1

Location: Rivers, Manitoba, R.M. of Daly

Legal Description: SW-25-12-21W

Date: November 1, 1983

Time: 11:00 A.M. to 12:15 P.M.

Total Depth: 9 Metres

Type Of Casing: Series 160 plastic

Type Of Screen: Slotted, Fiberglass wrap

Depth	Description
0 to 3.0 m.	Coarse gravel, some sand.
3.0 to 4.6 m.	Very coarse sand, some coarse gravel.
4.6 to 7.6 m.	Coarse sand and gravel, 50:50.
7.6 to 9.1 m.	Coarse gravel till, lots of clay.

GEOLOGIC LOG

Test Hole Identification: Rivers T.H. #2

Location: Rivers, Manitoba. R.M. of Daly

Legal Description: SW-25-12-21W

Date: November 1, 1983

Time: 2:00 P.M. to 4:00 P.M.

Total Depth: 9 Metres

Type Of Casing: Series 160 plastic

Type Of Screen: Slotted, Fiberglass wrap

Depth	Description
0 to 1.5 m.	Coarse brown sand.
1.5 to 3.0 m.	Coarse brown gravel grading to a coarse brown sand.
3.0 to 8.2 m.	Coarse gravel with about 30% coarse sand.
8.2 to 9.1 m.	Coarse gravel till, lots of clay.

APPENDIX D

Water Quality Analysis

Project: Phase II Landfill Study

Location: Rivers, R.M. of Daly. SE-26-12-21W

Sample #: 1

Date: Result A; November 1, 1983 Result B; January 12.1984

Parameter	Result A	Result B	Measured Unit
Conductivity	648.00	714.00	umho/cm
Residue Total	410.00	440.00	mg/l
Residue Filterable	510.00	440.00	mg/l
Residue Non Filterable	L 5.00	L 5.00	mg/l
pH	7.95	7.90	units
Alkalinity Total (CaCO3)	286.00	312.00	mg/l
Alkalinity (HCO3)	349.00	381.00	mg/l
Alkalinity (CO3)	0.00	0.00	mg/l
Alkalinity (OH)	0.00	0.00	mg/l
Arsenic, As	L 0.001	0.001	mg/l
Cadmium, Cd	L 0.001	L 0.001	mg/l
Copper, Cu	1.89	0.05	mg/l
Lead, Pb	L 0.005	L 0.005	mg/l
Zinc, Zn	3.04	4.06	mg/l
Chromium, Cr	L 0.005	L 0.005	mg/l
Calcium, Ca	82.60	98.40	mg/l
Magnesium, Mg	32.90	38.90	mg/l
Hardness (CaCO3)	342.00	406.00	mg/l
Manganese, Mn	0.07	0.05	mg/l
Iron, Fe	0.05	0.04	mg/l
Sodium, Na	4.06	4.30	mg/l
Color	-	-	units
Turbidity	0.70	0.45	NTU
Cyanide, CN	L 0.02	L 0.02	mg/l
NO3-NO2-N	1.00	1.78	mg/l
Chloride, Cl	24.00	25.00	mg/l
Sulphate, SO4	37.00	40.00	mg/l
Coliform Group	-	L 1.00	per 100 ml
Fecal Coliform	-	L 1.00	per 100 ml

L = Less Than

G = Greater Than

Water Quality Analysis

Project: Phase II Landfill Study

Location: Rivers, R.M. of Daly. SE-26-12-21W

Sample #: 2

Date: Result A; November 1, 1983 Result B; January 12, 1984

Parameter	Result A	Result B	Measured Unit
Conductivity	950.00	907.00	umho/cm
Residue Total	640.00	640.00	mg/l
Residue Filterable	640.00	640.00	mg/l
Residue Non Filterable	5.00	7.00	mg/l
pH	7.25	7.20	units
Alkalinity Total (CaCO3)	414.00	394.00	mg/l
Alkalinity (HCO3)	505.00	481.00	mg/l
Alkalinity (CO3)	0.00	0.00	mg/l
Alkalinity (OH)	0.00	0.00	mg/l
Arsenic, As	L 0.001	0.001	mg/l
Cadmium, Cd	L 0.001	L 0.005	mg/l
Copper, Cu	0.02	0.01	mg/l
Lead, Pb	L 0.005	L 0.005	mg/l
Zinc, Zn	0.12	0.05	mg/l
Chromium, Cr	L 0.005	L 0.005	mg/l
Calcium, Ca	122.00	119.00	mg/l
Magnesium, Mg	51.00	47.80	mg/l
Hardness (CaCO3)	515.00	494.00	mg/l
Manganese, Mn	0.21	0.23	mg/l
Iron, Fe	1.58	0.60	mg/l
Sodium, Na	13.20	13.70	mg/l
Color	-	-	units
Turbidity	7.50	5.00	NTU
Cyanide, CN	L 0.02	L 0.02	mg/l
NO3-NO2-N	0.04	L 0.01	mg/l
Chloride, Cl	15.00	12.00	mg/l
Sulphate, SO4	120.00	110.00	mg/l
Coliform Group	-	L 1.00	per 100 ml
Fecal Coliform	-	L 1.00	per 100 ml

L = Less Than

G = Greater Than

Water Quality Analysis

Project: Phase II Landfill Study

Location: Rivers, R.M. of Daly. SW-25-12-21W

Sample #: 3

Date: Result A; November 1, 1983 Result B; January 12, 1984

Parameter	Result A	Result B	Measured Unit
Conductivity	659.00	644.00	umho/cm
Residue Total	450.00	450.00	mg/1
Residue Filterable	450.00	450.00	mg/1
Residue Non Filterable	L 5.00	L 5.00	mg/1
pH	7.50	7.55	units
Alkalinity Total (CaCO3)	216.00	226.00	mg/1
Alkalinity (HCO3)	264.00	276.00	mg/1
Alkalinity (CO3)	0.00	0.00	mg/1
Alkalinity (OH)	0.00	0.00	mg/1
Arsenic, As	0.001	L 0.001	mg/1
Cadmium, Cd	L 0.001	L 0.001	mg/1
Copper, Cu	0.01	L 0.01	mg/1
Lead, Pb	L 0.005	L 0.005	mg/1
Zinc, Zn	0.12	0.08	mg/1
Chromium, Cr	L 0.005	L 0.005	mg/1
Calcium, Ca	77.20	82.30	mg/1
Magnesium, Mg	29.80	31.50	mg/1
Hardness (CaCO3)	316.00	335.00	mg/1
Manganese, Mn	L 0.02	L 0.02	mg/1
Iron, Fe	L 0.02	0.03	mg/1
Sodium, Na	7.20	7.95	mg/1
Color	-	-	units
Turbidity	0.25	0.20	NTU
Cyanide, CN	L 0.02	L 0.02	mg/1
NO3-NO2-N	12.00	8.40	mg/1
Chloride, Cl	12.00	9.00	mg/1
Sulphate, SO4	73.00	79.00	mg/1
Coliform Group	-	3.00	per 100 ml
Fecal Coliform	-	L 1.00	per 100 ml

L = Less Than

G = Greater Than

Water Quality Analysis

Project: Phase II Landfill Study

Location: Rivers, R.M. of Daly, SW-25-12-21W

Sample #: 4

Date: Result A; November 1, 1983 Result B; January 12, 1984

Parameter	Result A	Result B	Measured Unit
Conductivity	1290.00	1750.00	umho/cm
Residue Total	-	-	mg/l
Residue Filterable	-	1290.00	mg/l
Residue Non Filterable	-	-	mg/l
pH	8.25	7.85	units
Alkalinity Total (CaCO3)	278.00	362.00	mg/l
Alkalinity (HCO3)	339.00	442.00	mg/l
Alkalinity (CO3)	0.00	0.00	mg/l
Alkalinity (OH)	0.00	0.00	mg/l
Arsenic, As	0.003	0.001	mg/l
Cadmium, Cd	0.003	L 0.001	mg/l
Copper, Cu	0.03	0.02	mg/l
Lead, Pb	0.006	L 0.005	mg/l
Zinc, Zn	0.21	0.02	mg/l
Chromium, Cr	0.016	0.005	mg/l
Calcium, Ca	91.20	148.00	mg/l
Magnesium, Mg	54.80	75.80	mg/l
Hardness (CaCO3)	454.00	682.00	mg/l
Manganese, Mn	0.06	0.29	mg/l
Iron, Fe	0.71	0.10	mg/l
Sodium, Na	144.00	148.00	mg/l
Color	-	-	units
Turbidity	-	-	NTU
Cyanide, CN	-	-	mg/l
NO3-NO2-N	1.34	0.58	mg/l
Chloride, Cl	66.00	162.00	mg/l
Sulphate, SO4	335.00	355.00	mg/l
Coliform Group	-	1.00	per 100 ml
Fecal Coliform	-	1.00	per 100 ml

L = Less Than

G = Greater Than

Water Quality Analysis

Project: Phase II Landfill Study

Location: Rivers, R.M. of Daly. SW-25-12-21W

Sample #: 5

Date: Result A; November 1, 1983 Result B; January 12, 1984

Parameter	Result A	Result B	Measured Unit
Conductivity	802.00	703.00	umho/cm
Residue Total	-	-	mg/l
Residue Filterable	-	570.00	mg/l
Residue Non Filterable	-	-	mg/l
pH	8.20	8.00	units
Alkalinity Total (CaCO3)	210.00	210.00	mg/l
Alkalinity (HCO3)	256.00	256.00	mg/l
Alkalinity (CO3)	0.00	0.00	mg/l
Alkalinity (OH)	0.00	0.00	mg/l
Arsenic, As	0.004	0.001	mg/l
Cadmium, Cd	L 0.001	L 0.001	mg/l
Copper, Cu	0.03	0.04	mg/l
Lead, Pb	L 0.005	L 0.005	mg/l
Zinc, Zn	0.04	0.03	mg/l
Chromium, Cr	L 0.005	0.005	mg/l
Calcium, Ca	41.40	49.70	mg/l
Magnesium, Mg	23.20	25.70	mg/l
Hardness (CaCO3)	199.00	230.00	mg/l
Manganese, Mn	0.02	0.15	mg/l
Iron, Fe	0.54	0.30	mg/l
Sodium, Na	115.00	78.50	mg/l
Color	-	-	units
Turbidity	-	-	NTU
Cyanide, CN	-	-	mg/l
NO3-NO2-N	4.40	3.80	mg/l
Chloride, Cl	13.00	10.00	mg/l
Sulphate, SO4	170.00	145.00	mg/l
Coliform Group	-	L 1.00	per 100 ml
Fecal Coliform	-	L 1.00	per 100 ml

L = Less Than

G = Greater Than

3.4

DOUGLAS WASTE DISPOSAL GROUND

SE-3-11-17W

R.M. OF ELTON #1

3.4 Douglas Waste Disposal Ground

3.4.1 Location

The community of Douglas, Manitoba is located within the Rural Municipality of Elton, approximately 171 kilometers west of Winnipeg along P.R. 340. The waste disposal area is located about 151 metres south of the community and the legal description of the site is SE-3-11-17W.

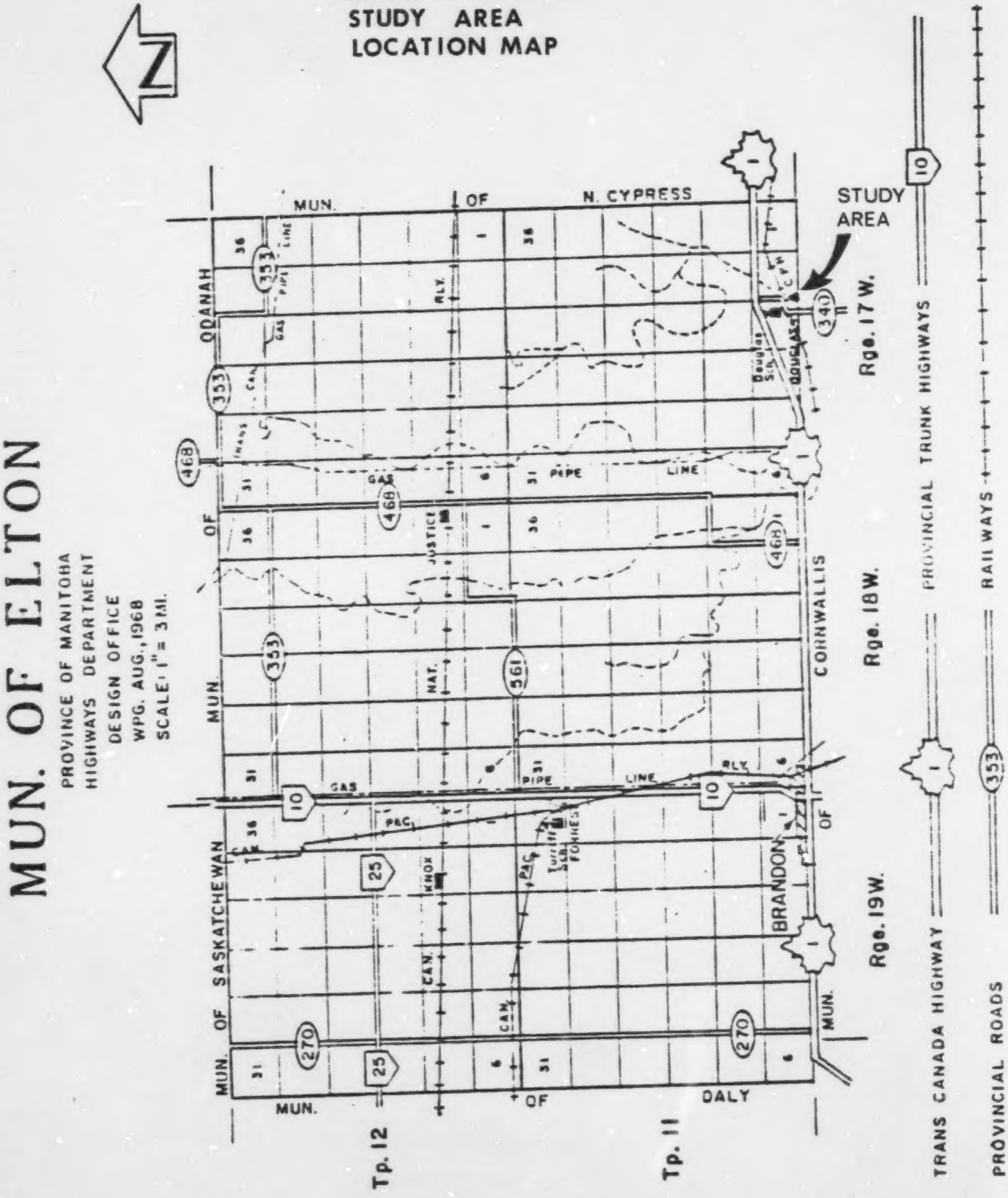
Figure A is a Rural Municipality map locating the study area and the Community of Douglas within the Rural Municipality of Elton.

3.4.2 Physiography

This region is characterized by extensive areas of marsh and bog overlying thick glacial sands and gravels. The topography of the area is fairly flat with seasonal flooding occurring in depressed swamp like areas. The area between the Community of Douglas and the waste disposal ground consists of sand and gravel deposits which have been excavated and are now filled with water. Depending on the depth of the excavations in these gravel and sand deposits, intersection with the groundwater table may have occurred. This area can now be considered a marsh or swamp type environment.

Surficial drainage from the waste disposal area would be towards these water filled excavations. Regional drainage would be from the north toward the Assiniboine River 11.3 kilometres south of the disposal site.

FIGURE A
STUDY AREA
LOCATION MAP


N
MUN. OF ELTON
PROVINCE OF MANITOBA
HIGHWAYS DEPARTMENT
DESIGN OFFICE
WPG. AUG., 1968
SCALE: 1"= 3 MI.
MUN. OF N. CYPRESS
MUN. OF SASKATCHEWAN
MUN. OF DALY
MUN. OF CORNWALLIS
ODANAH
BRANDON
DOUGLAS
Douglas Sch.
JUSTICE
KNOX
FORRES
STUDY AREA
C.P.R.
CAN. NAT. RLY.
CAN. PAC.
TRANS CAN. GAS PIPE LINE
GAS PIPE LINE
1
10
25
270
340
353
361
468
Rge. 17 W.
Rge. 18W.
Rge. 19W.
Tp. 12
Tp. 11
TRANS CANADA HIGHWAY
PROVINCIAL TRUNK HIGHWAYS
PROVINCIAL ROADS
RAILWAYS

3.4.3 Site Conditions

During the site visit on August 18, 1983, a number of observations were made with regard to the Douglas waste disposal facility. Pictures taken during this site visit serve to illustrate the conditions in and around the inactive area of disposal. These picutres can be found in Appendix A, along with a detailed description of each view.

The disposal site covers an area of approximately 91.2 metres in length, (north to south), by 46 metres in width, (east to west). This area is fenced by 1.2 metre high barbed wire fence. Access to the area is by a gravel road running south from the Town of Douglas. This gravel road is the southern extension of the government road allowance on the east side of town. A sign at the entrance to the disposal area gives instructions on the dumping procedures to be followed at this disposal site. Another sign, upside down and facing away from the road indicates that this particular waste disposal site is closed.

This waste disposal ground was closed in September of 1982. From the information gathered during phase one of this study and the site visit, it was learned that various types of domestic and municipal waste, including pesticide cans, oil and bulky metals were disposed of at this site. Surficial disposal and burial seems to have been the method of operation at this facility. Most of the waste has been compacted and covered with earth. The southern most face of the site is not completely covered exposing some of the waste. A fairly heavy grass cover can be found over most of the disposal area. The elevation of the disposal site reaches about 2.4 metres above grade. Figure B details the plan view of the site.

3.4.4 Surficial Geology and Hydrogeology

In general the surficial geology around the Douglas waste disposal area can be directly related to a pro-glacial or glacial environment. Over most of the region non-glacial marsh, fen, swamp and bog deposits up to 6 metres thick overlie the pro-glacial lake sediments. These glaciolacustrine deposits are primarily, clay, silt, sand and some minor gravel 1 to 30 metres in thickness. Deltaic deposits of this type are generally widespread over entire regions. Fairly extensive dune development may be encountered from place to place in this type of setting.

The area directly in and around the Douglas waste disposal ground consists of up to 10 metres of sand and gravel overlying glacial till interbedded with sand and gravel layers. The total thickness of these surficial deposits is up to 30 metres.

The bedrock in the Douglas area is a fairly hard shale. Very little fracturing occurs in the upper shale, therefore, groundwater movement in this zone is minimal. The surficial sands and gravels constitute the major aquifers in this area. The sand and gravel interbedded in the till is also water bearing. Most of the domestic water supplies in the Douglas area are drawn from the shallow surficial sand and gravel aquifer.

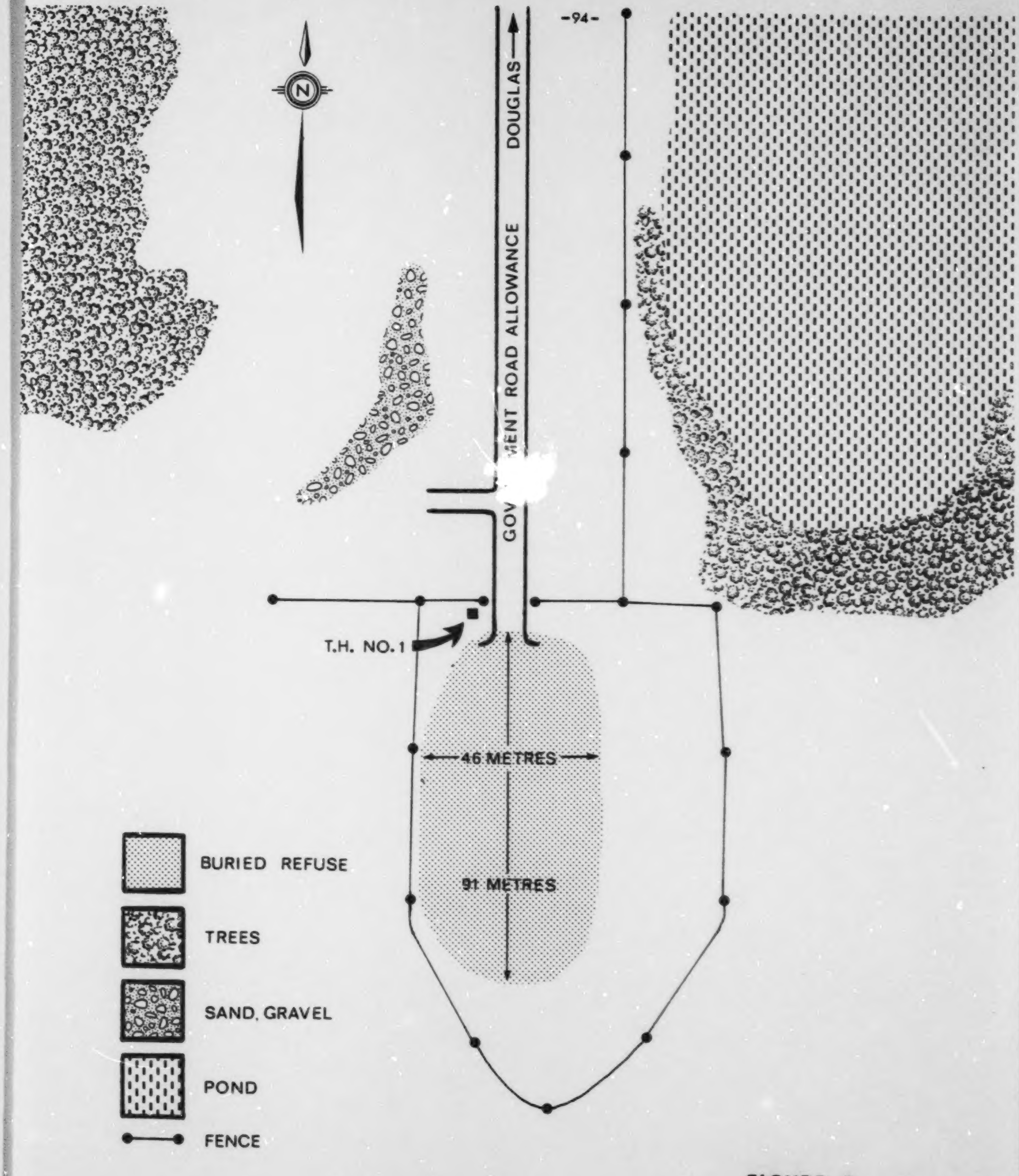

N
DOUGLAS
GOV MENT ROAD ALLOWANCE
T.H. NO.1
46 METRES
91 METRES
BURIED REFUSE
TREES
SAND, GRAVEL
POND
FENCE

FIGURE B

SITE PLAN

SCALE 1:1250

The Water Resources Branch, Department of Natural Resources, Province of Manitoba was requested to complete a groundwater pollution hazard appraisal for the Douglas waste disposal facility. A copy of this appraisal can be found in Appendix B. Basically the comments made on the appraisal agree with the above general geology. This disposal site is located in an area designated a groundwater pollution hazard area because of the shallow surficial sand and gravel aquifer around the waste disposal ground. A field investigation, including test drilling and monitoring well installation was formulated in order to confirm subsurface geologic and hydrogeologic conditions at the disposal site.

On October 31, 1983 one 9 metre deep test hole was drilled at the Douglas waste disposal site using the mud rotary drilling method. A monitoring well was installed in the test hole. T.H. #1 was drilled to 9 metres for geologic confirmation. Because the surficial sands and gravels extending to the bottom of the test hole the 51 mm. I.D. monitoring well was set to 9 metres, with the last 1.2 metres slotted and wrapped with fiberglass well screening material. A geologic log for the test hole drilled can be found in Appendix C. Soil samples taken during the test drilling program have been retained for future reference. The test hole location can be found on Figure B.

3.4.5 Groundwater Sampling

On November 1, 1983, and again on January 11, 1984, groundwater samples were collected from two residences approximately

176 metres north of the disposal site and the established monitoring well. These samples were submitted to the W. M. Ward Technical Services Laboratory for analysis. Bacteriological samples were submitted to the Cadham Provincial Laboratory for testing. The results of these analyses can be found in Appendix D.

Figure C is an air photo of the study area at a scale of 1:15840. This photo shows the location of the study area with respect to the Community of Douglas. The groundwater sampling points established during the field investigation of this waste disposal site have been located on this air photo.

3.4.6 Analytical Results and Conclusions

With regard to the inactive Douglas waste disposal facility and the phase two assessment of the site, there is no observed effect on the surrounding environment. Data collected throughout the study shows no hazard to the public health which can be directly attributed to the waste disposal ground.

Groundwater

Because the waste disposal ground is considered to be in a groundwater pollution hazard area, a test drilling program was established to identify the surficial geologic and hydrogeologic conditions in and around the site. Based on the information gathered from the test hole drilled and the exposed sand and gravel in the area immediately north of the waste facility, it would seem that the Douglas waste disposal site is located on a fairly permeable surficial

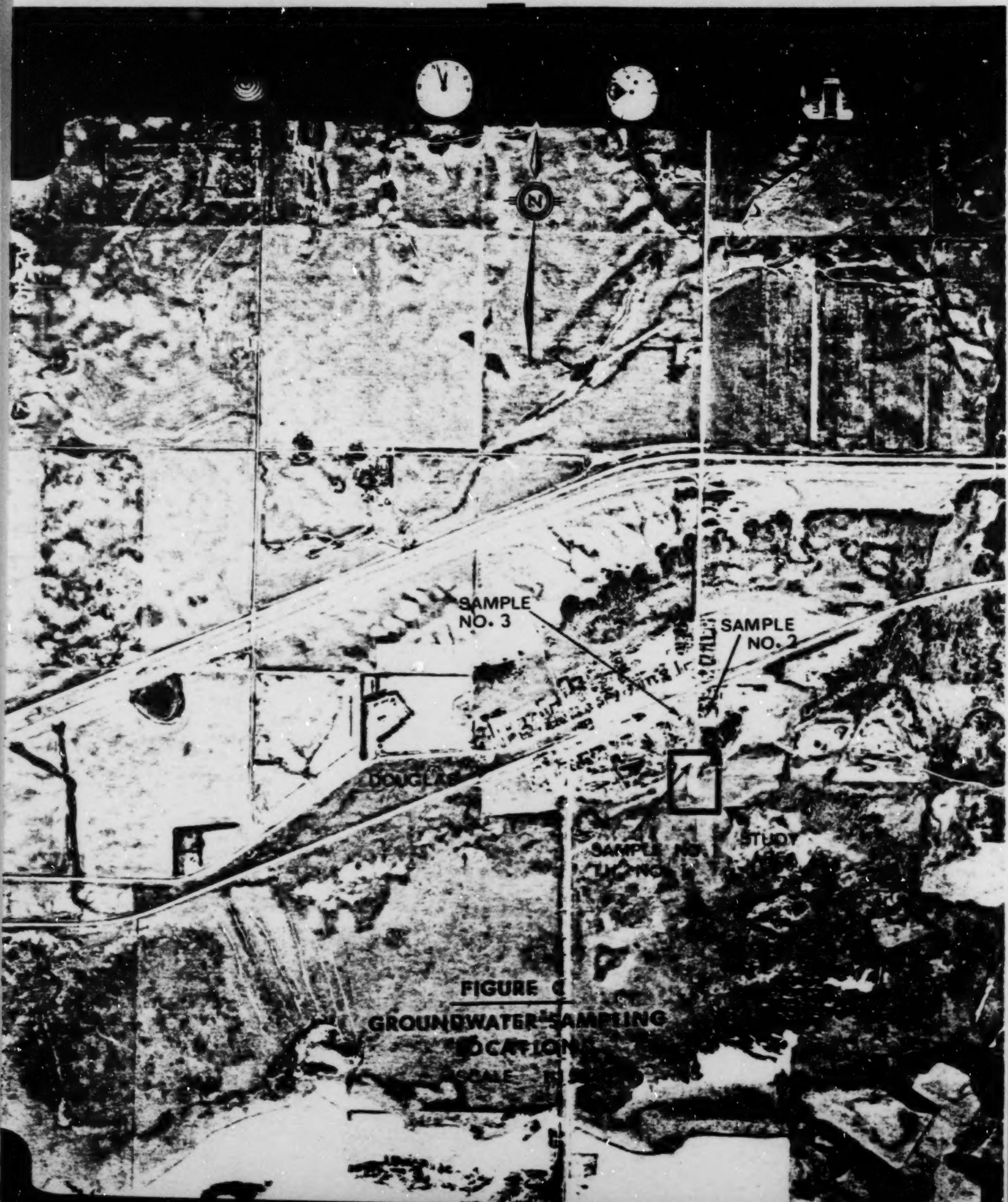

N
SAMPLE NO. 3
SAMPLE NO. 2
DOUGLAS
SAMPLE NO. 1
STUDY

FIGURE C

GROUNDWATER SAMPLING LOCATIONS

SCALE [illegible]

sand and gravel deposit. These water bearing surficial sands are uniform in grain size for the first 7.6 metres, as a coarse gravel. From 7.6 metres to 9 metres this coarse gravel grades to a fine sand. The groundwater level is about .8 metres below grade or 3.2 metres below the top of the waste site. Any leachate produced at this waste site can enter the groundwater aquifer fairly easily. Regional groundwater flow is expected to be from north to south.

Water quality analyses conducted on the two domestic water supplies and the established monitoring well were compared to the "Guidelines to Canadian Drinking Water Quality" prepared by Health and Welfare Canada in 1978. These groundwater supplies can be described in general as good quality for domestic purposes.

No indications of groundwater contamination were found in the laboratory tests conducted on the water samples. These results seem to indicate that the groundwater flow is moving south away from the Town of Douglas, as expected. Contamination of the groundwater aquifer used for domestic water supplies, is not of concern at this time with respect to the Douglas waste disposal facility. Further sampling of the domestic groundwater supplies and the established monitoring well, on a periodic basis, is advisable to confirm that groundwater contamination is not occurring in the future.

Methane

Mathane gas produced through the decomposition of buried domestic waste can be of concern to buildings located in close proximity to waste disposal sites. Methane gas migration, in this case, is possible through the surficial sands and gravels. However, because the method of disposal at this site was above ground deposition of waste and the distance to the nearest building is approximately 176 metres, methane production, if any, is not of concern.

It should be noted that explosimeter tests for methane gas were conducted during the test drilling program and at each sampling of the monitoring well, no positive readings were recorded.

Surface Water

Surface water pollution from the waste disposal ground may only effect the water contained in the gravel and sand pits excavated approximately 65 metres north of the disposal site. These pits are now unused and support a marsh or swamp type environment. It is believed that these gravel pit excavations intersect the groundwater table at this particular site. Groundwater contaminated by leachates from the waste disposal facility may find its way into these small swamps. In this case, however, because the groundwater flow seems to be southward, away from these pits, groundwater migration is not a concern. Surficial runoff through the waste to the water containing gravel pits is not of concern because runoff water would be absorbed by the coarse surficial sands and gravels of the area.

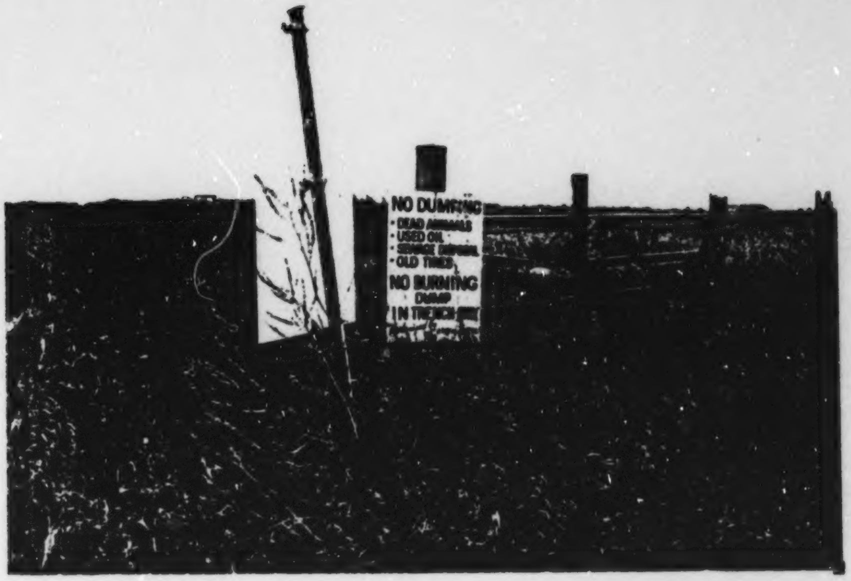
3.4.7 Recommendations

1) It is recommended that periodic collection of groundwater samples from local domestic water supplies and the established monitoring well, be undertaken to confirm that groundwater contamination does not occur in the future.
2) The exposed waste on the southern face of the disposal area should be properly covered.
3) The disposal procedures sign at the entrance to the facility should be removed and the "Garbage Dump Closed" sign should be turned upright and placed facing the entrance road.
4) The gate should be closed and locked across the site entrance.

5) A cover of low permeability earthern material compacted to a thickness of .6 metres should be applied to the top flat surface of the disposal area and contoured in such a way as to allow rain water and melt water to run off the site.

6) Refer to Manitoba Regulation 208/76 under the Clean Environment Act for further clarification of these recommendations and other waste disposal ground operating procedures.

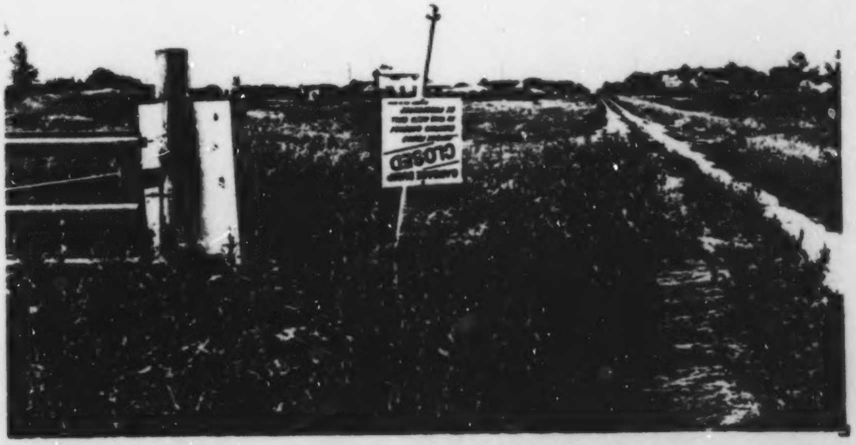
APPENDIX A


NO DUMPING
DEAD ANIMALS
USED OIL
SEWAGE DISPOSAL
OLD TIRES
NO BURNING
DUMP
IN TRENCH ONLY

Date: August 18, 1983 Location: Douglas Waste Disposal Ground

Orientation: Taken from Government road allowance looking south.

Comments: Sign at entrance to waste disposal area. Note gate open and the second sign facing the wrong way. The truck in the center left of the picture is located in the center of the inactive disposal area.



Date: August 18, 1983 Location: Douglas Waste Disposal Ground

Orientation: Taken from just inside the disposal area entrance looking north.

Comments: This view shows the upside down site closed sign and the access road to the site. This road is an extension of the Government road allowance through the town of Douglas.

Date: August 18, 1983 Location: Douglas Waste Disposal Ground

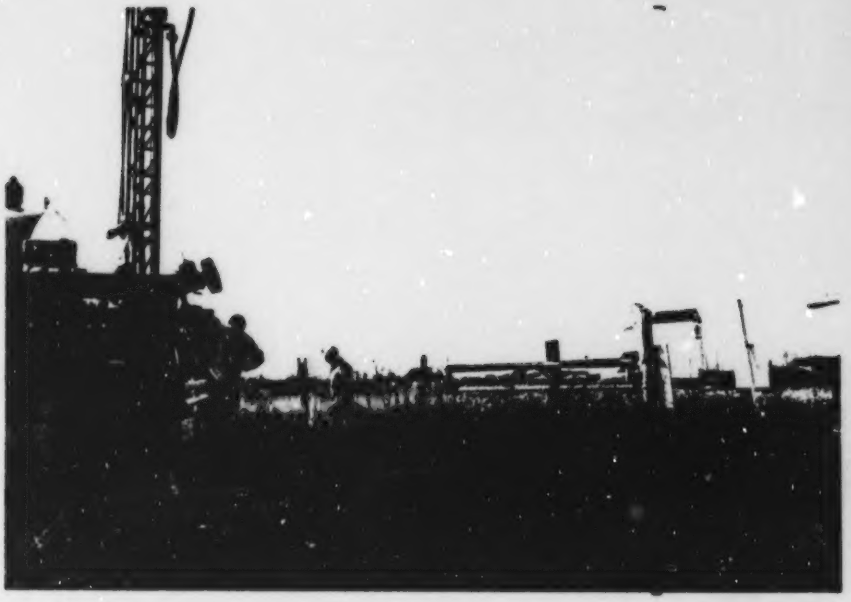
Orientation: Taken from the east side of the site looking west.

Comments: The site is elevated above the level of the surrounding land. Note fairly good vegitation cover at this site. The left end of the disposal mound (southern exposure) shows bared waste.

Date: August 18, 1983 Location: Douglas Waste Disposal Ground

Orientation: From the top of the disposal pile in a southerly direction.

Comments: Note exposed waste not covered when site closed. This is only evident on the southern exposure of this disposal site.



Date: October 31, 1983 Location: Douglas Waste Disposal Ground

Orientation: Inside the disposal ground gate looking north-west.

Comments: Drilling of test hole #1. A monitoring well was installed at this site.

APPENDIX B

FILE No. 5.7.4.2.

WATER RESOURCES BRANCH

GROUNDWATER POLLUTION HAZARD APPRAISAL

POTENTIAL SOURCE OF POLLUTION	Waste Disposal Ground
LOCATION OF SOURCE	SE-3-11-17W
OWNER OF SOURCE	R.M. of Elton, Douglas

GEOLOGICAL CONDITIONS	SURFICIAL DEPOSITS	Up to 7 m of sand and gravel underlain by glacial till with a few layers of sand and gravel. The total thickness of the surficial deposits is more than 30 m.
	BEDROCK	Shale.

GROUNDWATER CONDITIONS	AQUIFERS	The surface sand and gravel constitute the main aquifer in the area. The sand and gravel interbedded in the till is also water bearing.
	WELLS	All wells reported in the vicinity draw water from the shallow sand and gravel aquifers.

POLLUTION HAZARD

Because the aquifer forming sand and gravel is exposed, groundwater pollution hazard exists on this quarter section.

COMMENTS

BY: ______________________
GROUNDWATER GEOLOGIST
M. Rutulis, P. Eng.

DATE: Dec. 7, 1983

APPENDIX C

GEOLOGIC LOG

Test Hole Identification: Douglas T.H. #1

Location: Douglas, Manitoba. R.M. of Elton.

Legal Description: SE-3-11-17W

Date: October 31, 1983

Time: 4:15 P.M. to 6:00 P.M.

Total Depth: 9 Metres

Type Of Casing: Series 160, Plastic

Type Of Screen: Slotted, Fiberglass Wrap

Depth	Description
0 to 1.5 m.	Top soil, organics.
1.5 to 7 m.	Very coarse gravel, gray.
7 to 7.6 m.	Coarse gravel to medium sand, gray.
7.6 to 9.0 m.	Some coarse gravel, mostly medium to fine sand, gray.

APPENDIX D

Water Quality Analysis

Project: Phase II Landfill Study

Location: Douglas, R.M. of Elton. SE-3-11-17W

Sample #: 1

Date: Result A; November 1, 1983 Result B; January 11, 1984

Parameter	Result A	Result B	Measured Unit
Conductivity	974.00	906.00	umho/cm
Residue Total	700.00	-	mg/l
Residue Filterable	690.00	660.00	mg/l
Residue Non Filterable	14.00	-	mg/l
pH	7.55	7.60	units
Alkalinity Total (CaCO3)	242.00	264.00	mg/l
Alkalinity (HCO3)	295.00	322.00	mg/l
Alkalinity (CO3)	0.00	0.00	mg/l
Alkalinity (OH)	0.00	0.00	mg/l
Arsenic, As	L 0.001	0.001	mg/l
Cadmium, Cd	0.001	0.001	mg/l
Copper, Cu	L 0.01	0.06	mg/l
Lead, Pb	L 0.005	L 0.005	mg/l
Zinc, Zn	0.06	0.12	mg/l
Chromium, Cr	L 0.005	L 0.005	mg/l
Calcium, Ca	88.40	88.70	mg/l
Magnesium, Mg	46.60	48.20	mg/l
Hardness (CaCO3)	413.00	420.00	mg/l
Manganese, Mn	0.03	0.19	mg/l
Iron, Fe	0.30	0.11	mg/l
Sodium, Na	54.10	45.70	mg/l
Color	-	-	units
Turbidity	4.00	-	NTU
Cyanide, CN	L 0.02	-	mg/l
NO3-NO2-N	0.90	L 0.01	mg/l
Chloride, Cl	32.00	29.00	mg/l
Sulphate, SO4	230.00	200.00	mg/l
Coliform Group	-	L 1.00	per 100 ml
Fecal Coliform	-	L 1.00	per 100 ml

L = Less Than

G = Greater Than

Water Quality Analysis

Project: Phase II Landfill Study

Location: Douglas, R.M. of Elton. SW-2-11-17W

Sample #: 2

Date: Result A; November 1, 1983 Result B; January 11,1984

Parameter	Result A	Result B	Measured Unit
Conductivity	1210.00	1230.00	umho/cm
Residue Total	870.00	920.00	mg/l
Residue Filterable	870.00	920.00	mg/l
Residue Non Filterable	L 5.00	L 5.00	mg/l
pH	7.45	7.35	units
Alkalinity Total (CaCO3)	326.00	318.00	mg/l
Alkalinity (HCO3)	398.00	388.00	mg/l
Alkalinity (CO3)	0.00	0.00	mg/l
Alkalinity (OH)	0.00	0.00	mg/l
Arsenic, As	L 0.001	L 0.001	mg/l
Cadmium, Cd	L 0.001	L 0.001	mg/l
Copper, Cu	0.04	0.07	mg/l
Lead, Pb	L 0.005	L 0.005	mg/l
Zinc, Zn	0.12	0.08	mg/l
Chromium, Cr	0.005	L 0.005	mg/l
Calcium, Ca	138.00	161.00	mg/l
Magnesium, Mg	58.80	66.80	mg/l
Hardness (CaCO3)	587.00	677.00	mg/l
Manganese, Mn	L 0.02	L 0.02	mg/l
Iron, Fe	0.03	L 0.02	mg/l
Sodium, Na	31.00	30.00	mg/l
Color	-	-	units
Turbidity	0.45	0.20	NTU
Cyanide, CN	L 0.02	L 0.02	mg/l
NO3-NO2-N	3.70	2.95	mg/l
Chloride, Cl	28.00	27.00	mg/l
Sulphate, SO4	315.00	325.00	mg/l
Coliform Group	-	L 1.00	per 100 ml
Fecal Coliform	-	L 1.00	per 100 ml

L = Less Than

G = Greater Than

Water Quality Analysis

Project: Phase II Landfill Study

Location: Douglas, R.M. of Elton. SW-3-11-17W

Sample #: 3

Date: Result A; November 1, 1983 Result B; January 11, 1984

Parameter	Result A	Result B	Measured Unit
Conductivity	1280.00	1320.00	umho/cm
Residue Total	960.00	970.00	mg/l
Residue Filterable	960.00	970.00	mg/l
Residue Non Filterable	L 5.00	L 5.00	mg/l
pH	7.60	7.45	units
Alkalinity Total (CaCO3)	322.00	322.00	mg/l
Alkalinity (HCO3)	393.00	393.00	mg/l
Alkalinity (CO3)	0.00	0.00	mg/l
Alkalinity (OH)	0.00	0.00	mg/l
Arsenic, As	L 0.001	L 0.001	mg/l
Cadmium, Cd	L 0.001	L 0.001	mg/l
Copper, Cu	0.02	0.02	mg/l
Lead, Pb	L 0.005	L 0.005	mg/l
Zinc, Zn	0.04	0.03	mg/l
Chromium, Cr	L 0.005	L 0.005	mg/l
Calcium, Ca	158.00	164.00	mg/l
Magnesium, Mg	74.20	74.50	mg/l
Hardness (CaCO3)	700.00	717.00	mg/l
Manganese, Mn	L 0.02	L 0.02	mg/l
Iron, Fe	0.05	0.02	mg/l
Sodium, Na	45.20	48.80	mg/l
Color	-	-	units
Turbidity	0.30	0.20	NTU
Cyanide, CN	L 0.02	L 0.02	mg/l
NO3-NO2-N	4.40	3.30	mg/l
Chloride, Cl	50.00	50.00	mg/l
Sulphate, SO4	325.00	340.00	mg/l
Coliform Group	-	L 1.00	per 100 ml
Fecal Coliform	-	L 1.00	per 100 ml

L = Less Than

G = Greater Than

3.5

NEEPAWA, SALT MINE WASTE DISPOSAL GROUND

NW-34-14-15W

R.M. OF LANGFORD #2

3.5 Neepawa, Salt Mine Waste Disposal Ground

3.5.1 Location

The Town of Neepawa, Manitoba is located within the Rural Municipality of Langford, approximately 158 kilometres north-west of Winnipeg along P.T.H. 16. The waste disposal area is located within the Town of Neepawa at a site now occupied by the Yellowhead Center. The legal description of the site is NW-34-14-15W.

Figure A is a Rural Municipality Map locating the study area within the Town of Neepawa.

3.5.2 Physiography

This region is characterized by extensive, thick glacial lake deposition creating a flat prairie with little topographic relief. Surface relief in the area takes the form of the Whitemud River channel, located east of the disposal area. The Whitemud River Valley cuts its way through what was once a much wider glacial river valley. The slope of the valley walls is fairly steep, and in some places this valley cuts as deep as 23 metres below the grade of the surrounding prairie.

Surficial drainage for the area around the Yellowhead Center is to the roadways on the south, west and north sides of the property. On the east side, surficial drainage is to a community recreation field. Regional drainage is from west to east toward the Whitemud River.

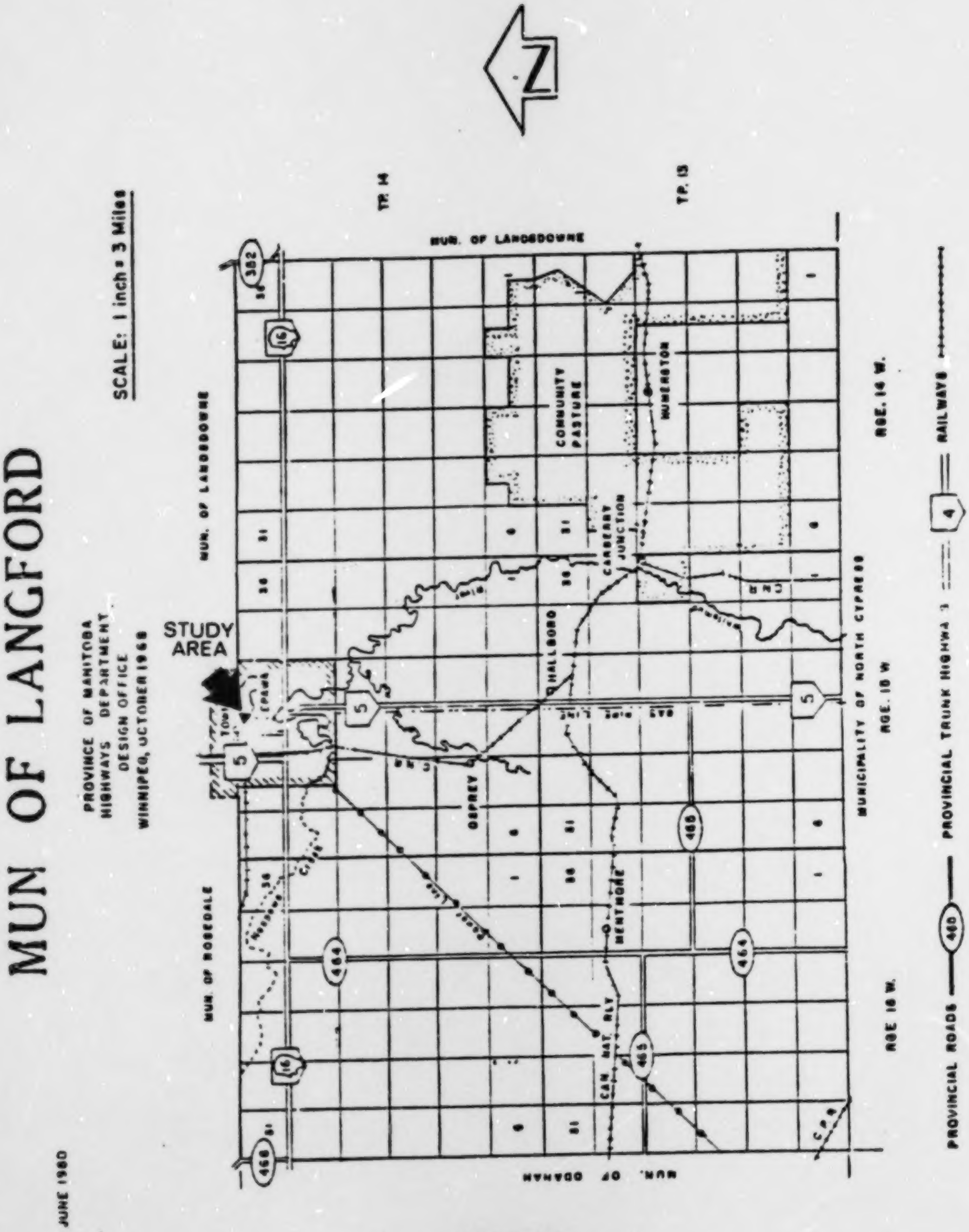

N
MUN OF LANGFORD
PROVINCE OF MANITOBA
HIGHWAYS DEPARTMENT
DESIGN OFFICE
WINNIPEG, OCTOBER 1968
SCALE: 1 inch = 3 Miles
REVISED:- JUNE 1980
STUDY AREA
MUN. OF ROSEDALE
MUN. OF LANSDOWNE
MUN. OF ODANAH
MUNICIPALITY OF NORTH CYPRESS
TP. 14
TP. 15
RGE. 16 W.
RGE. 15 W.
RGE. 14 W.
OSPREY
HALLBORO
WENTHORNE
CARBERRY JUNCTION
COMMUNITY PASTURE
CAN. NAT. RLY
C.P.R.
C.N.R.
5
16
382
464
465
466
PROVINCIAL ROADS
460
PROVINCIAL TRUNK HIGHWAY
4
RAILWAYS

FIGURE A

STUDY AREA LOCATION MAP

Figure B is a Town of Neepawa map locating the study area within the Town of Neepawa.

3.5.3 Site Conditions

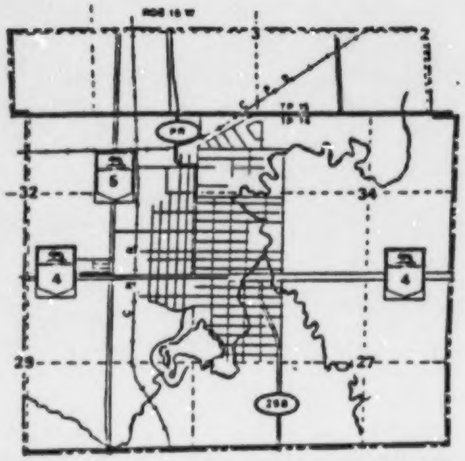
During the site visit on August 18, 1983, a number of observations were made with regard to the Neepawa Salt Mine waste disposal facility. Pictures taken during the site visit serve to illustrate the conditions in and around the inactive area of disposal. These pictures can be found in Appendix A along with a detailed description of each view.

From information gathered during the site visit and from interviews with personnel associated with the now closed Neepawa Salt Mine, details as to facilities and site usage were collected. Apparently the building which is now the Yellowhead Center, was once the mine bulk storage facility. The salt recovery operation was supplied with brine from a 517 metre deep well located on the south side of the Yellowhead Center building. This brine was pumped to a settling pond, where, through an evaporation process the salt was removed from the brine liquid. Waste from this settling pond was combined with coal ash from the mine's power plant and disposed of in an area at the east end of the brine pond. This area has been described as the mine's waste disposal area. Domestic and municipal wastes were not deposited at this site.

The exact location of the brine pond is not known but is believed to be east of the Yellowhead Center building partially under

No. 46 A

TOWN OF NEEPAWA



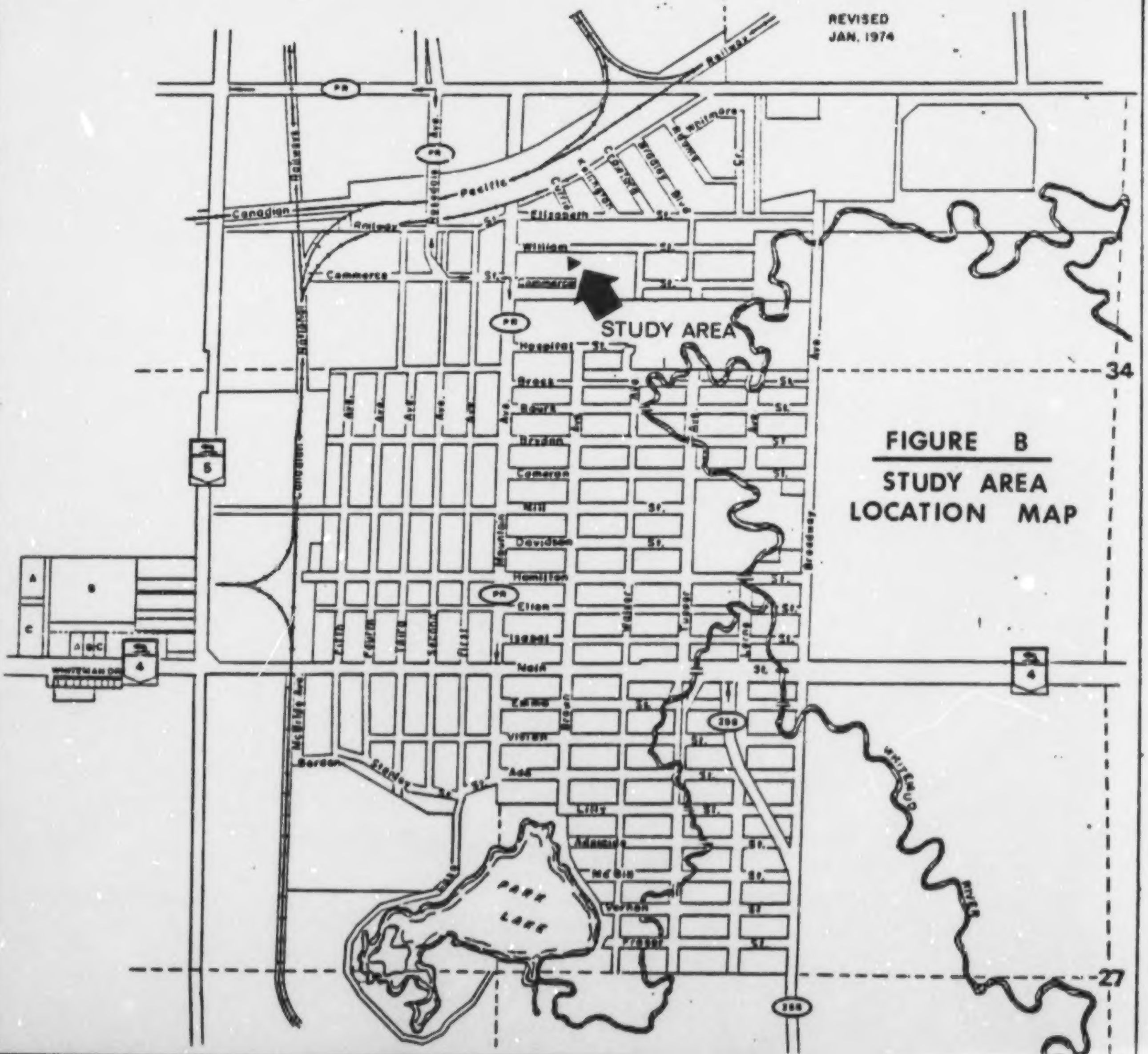
32
34
29
27
5
4
4

KEY MAP AS TO TOWN BOUNDARIES

800 0 1000 2000 3000
SCALE IN FEET

PROVINCE OF MANITOBA
DEPARTMENT OF PUBLIC WORKS
AND HIGHWAYS
DESIGN OFFICE
WINNIPEG MAY 1971

REVISED
JAN. 1974



N
Canadian Pacific Railway
Elizabeth St.
William St.
Commerce St.
STUDY AREA
Hospital St.
34
27
5
4
4
PARK LAKE
WHITEMUD RIVER
Main St.
Broadway Ave.

FIGURE B
STUDY AREA
LOCATION MAP

the attached indoor ice rink. The dimensions of the actual area of disposal are also unknown. Apparently the east end of the indoor ice rink and the adjoining outdoor hockey rink have been built upon the disposal area. From descriptions supplied through the interviews conducted, an approximation of the disposal area has been indicated on Figure C which details the plan view of the site.

3.5.4 Surficial Geology and Hydrogeology

In general the surficial geology of the Neepawa area can be directly related to a pro-glacial or glacial environment. Glaciofluvial deposits 1 to 100 metres thick are common for this area. Clay, silt, sand and some minor amounts of gravel were deposited in an ice marginal environment. Outwash deposition and glacial valley fill deposits are common in this setting. Surficial sands up to 6 metres in depth may overlie sequences of glacial till over 60 metres thick.

The bedrock in the area is commonly hard unfractured shale. This lack of fracturing limits the amount of groundwater availability in the shale zone. The surficial sand deposits form the most common aquifers in the area. Lenses of sand and gravel interbedded in the glacial till may form isolated groundwater aquifers. Most of the domestic water supplies in the Neepawa area are drawn from the surficial sand and gravel deposits.

The Water Resources Branch, Department of Natural Resources, Province of Manitoba was requested to complete a groundwater pollution hazard appraisal for the Neepawa Salt Mine waste disposal facility. A

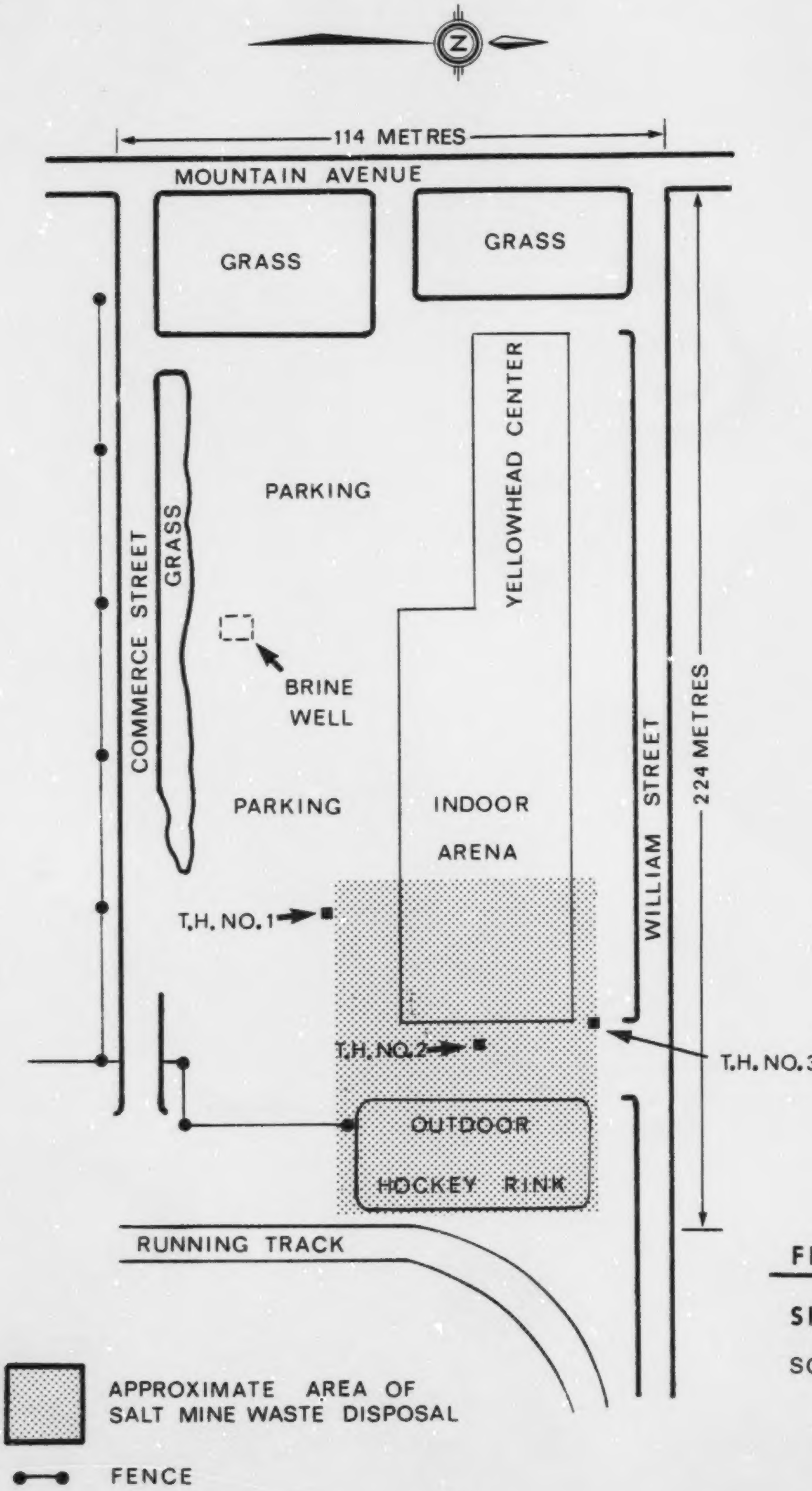

N
114 METRES
MOUNTAIN AVENUE
GRASS
GRASS
YELLOWHEAD CENTER
PARKING
GRASS
COMMERCE STREET
BRINE
WELL
PARKING
INDOOR
ARENA
WILLIAM STREET
224 METRES
T.H. NO. 1
T.H. NO. 2
T.H. NO. 3
OUTDOOR
HOCKEY RINK
RUNNING TRACK
APPROXIMATE AREA OF
SALT MINE WASTE DISPOSAL
FENCE

FIGURE C

SITE PLAN

SCALE 1:1250

copy of this appraisal can be found in Appendix B. Basically, the comments made on the appraisal agree with the above general geology. This disposal area is located in an area designated a groundwater pollution hazard area because the sand forming the surficial aquifers is exposed in places. A field investigation including test drilling and possible monitoring well installation was indicated in order to confirm subsurface conditions.

On October 31, 1983, three test holes were drilled at the Neepawa Salt Mine waste disposal area using the mud rotary drilling method. T.H. #1 was drilled to 12 metres for geologic confirmation. T.H.'s #2 and #3 were drilled to 9 metres to determine the subsurface conditions. In all three holes an amount of sand, gravel, clay fill mixed with asphalt and oil was encountered for the first metre or so at surface. This material has been used to fill the brine pond and foundation remains of the salt mine facility. It is expected that this fill material extends over the entire area under and around the Yellowhead Center indoor ice rink. This fill has caused the study area to be approximately 1 metres higher than the surrounding house lots, roadways and community recreation field.

Below the surficial fill material, light brown clay till, grading to dark tight gray clay and further into dark gray clay till seems to be the common depositional sequence. Because of the low permeability clay till material underlying the study area, groundwater monitoring wells were not installed. Geologic logs for the test holes drilled can be found in Appendix C. Soil samples taken during the test drilling program have been retained for future reference. The test hole locations can be found on Figure C.

3.5.5 Soil Testing

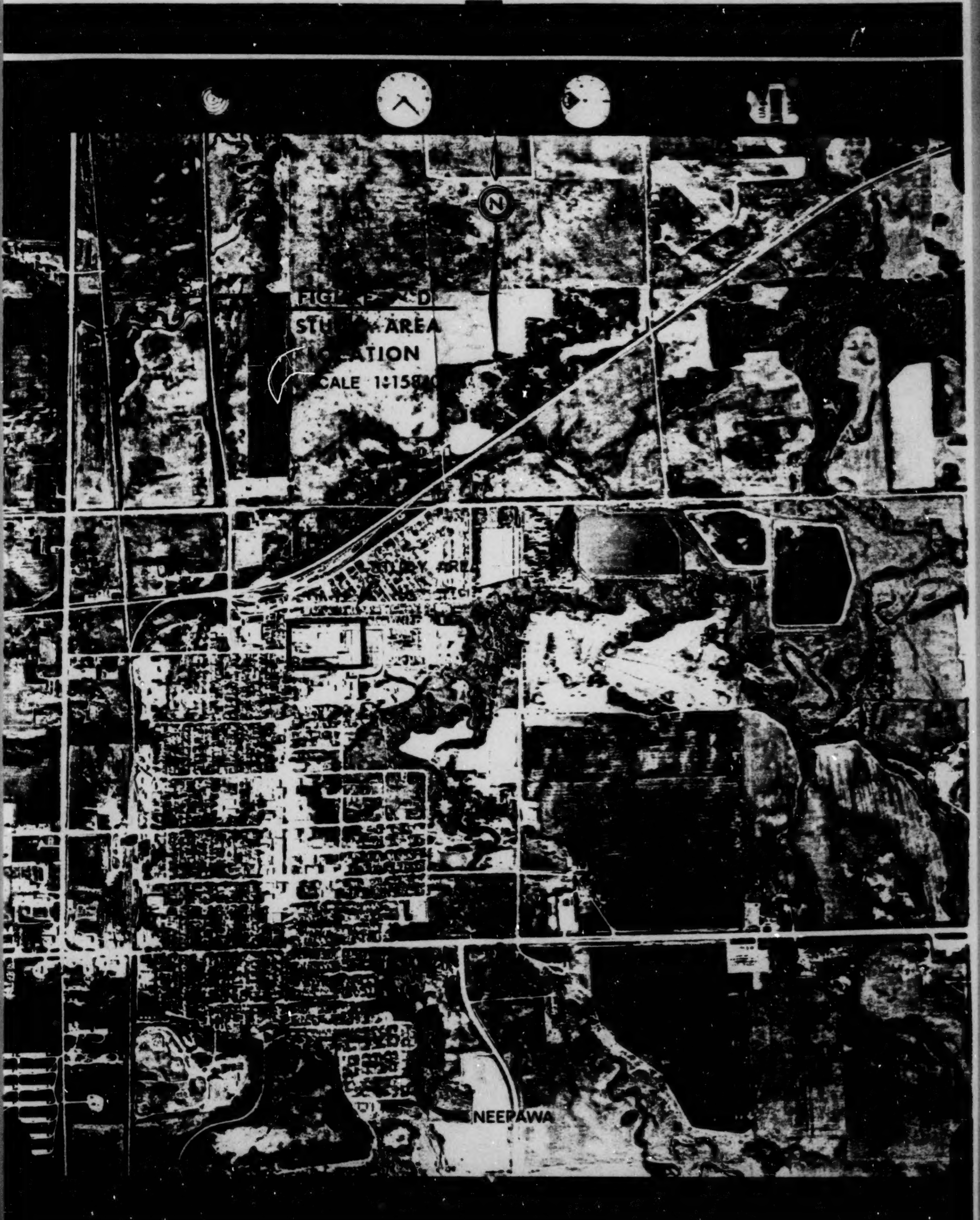
One sample taken from T.H. #2 at 1.5 to 3.7 metres in depth was submitted to the Manitoba Provincial Soil Testing Laboratory for a detailed soil analysis report. Upon recovery this sample showed unfamiliar characteristics and it was felt that it may be a sample containing a discarded brine pond waste and coal ash mixture. The results of the analysis indicated a sodium content higher than would normally be expected in the well drained soil types indigenous to this area.

From this information it is expected that some of the waste brine may have leached into the fill material deposited over the brine pit and waste disposal areas. The soil analysis results can be found in Appendix D.

3.5.6 Groundwater Sampling

Because of the clay till formation underlying the Yellowhead Center and attached indoor ice rink, groundwater monitoring wells were not installed. Domestic groundwater supply wells were not available in the vicinity of the study area, therefore, samples were not obtained from these sources.

Figure D is an air photo of the study area at a scale of 1:15840. This photo shows the location of the study area within the Town of Neepawa.


N
FIG[illegible] D
STU[illegible] AREA
[illegible]CATION
[illegible]CALE 1:158[illegible]
STUDY AREA
NEEPAWA

3.5.7 Analytical Results and Conclusions

With regard to the inactive Neepawa Salt Mine waste disposal facility and the phase two assessment of the site, there is no observed effect on the surrounding environment. Data collected throughout the study shows no hazard to the public health which can be directly attributed to this waste disposal ground.

Groundwater

Because the site is considered to be in a groundwater pollution hazard area, a test drilling program was established to identify the surficial geologic and hydrogeologic conditions in and around the study area. T.H. #1 and T.H. #2 show 1.5 to 2.4 metres of fill material deposited over the site and increasing in thickness from north to south. T.H. #3 shows up to 1 metre of medium brown sand, probably fill and another 2 metres of coarse sand which may represent the edge of a surficial sand deposit located north of the indoor ice rink.

Underlying the surficial fill in the case of T.H. #1 and T.H. #2 and below the surficial sand in T.H. #3, is a fairly tight brown clay till. These deposits contain a high percentage of clay and therefore, have a low permeability. Groundwater movement in the area directly around the site is restricted because of this clay till formation. Because of this restricted groundwater movement and the absence of groundwater supply wells in the vicinity of the inactive disposal site, groundwater contamination is not a concern with respect to the Neepawa Salt Mine waste disposal ground.

Methane

Methane gas produced through the decomposition of buried domestic waste can be of concern to buildings in close proximity to waste disposal sites. In this case, however, brine pond waste and coal ash would not produce methane gas, and, therefore, cannot be considered a concern at this particular site.

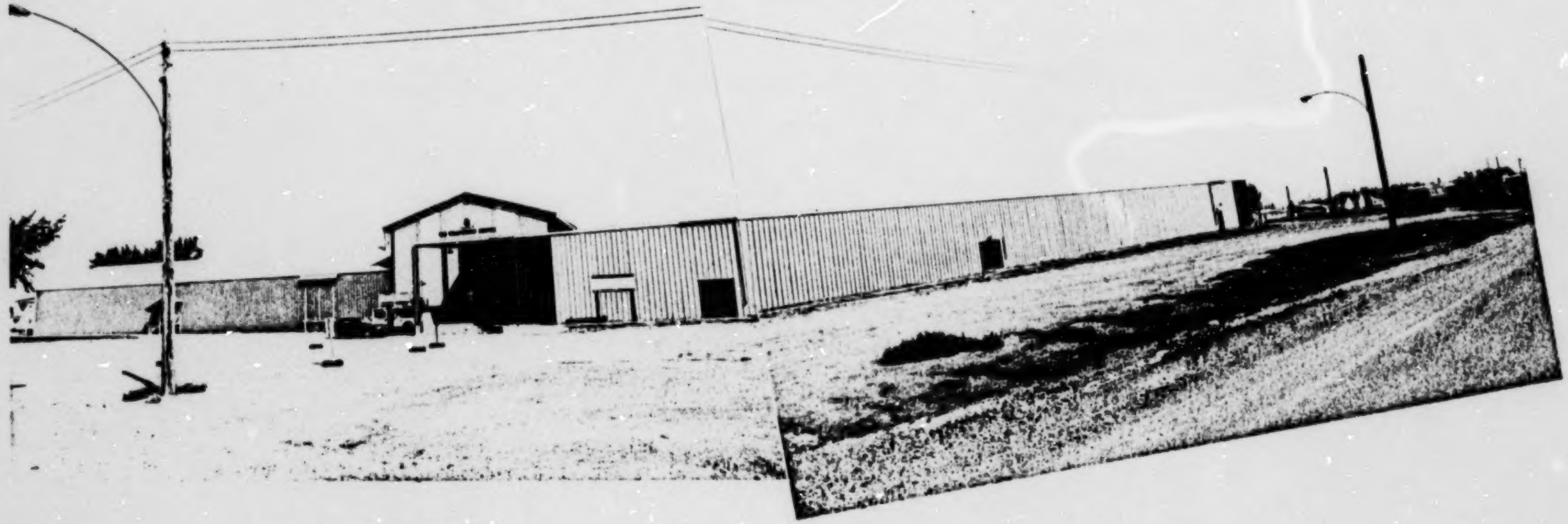
Surface Water

Surface water pollution from this waste disposal ground is not likely to occur in this area. The nearest body of water is the Whitemud River 477 metres east of the study area. Contamination from surficial runoff or groundwater migration will not occur because of the distance to the river and the surficial soil conditions in and around the inactive brine and ash disposal area.

3.5.8 Recommendations

1) No further action is required for this site.

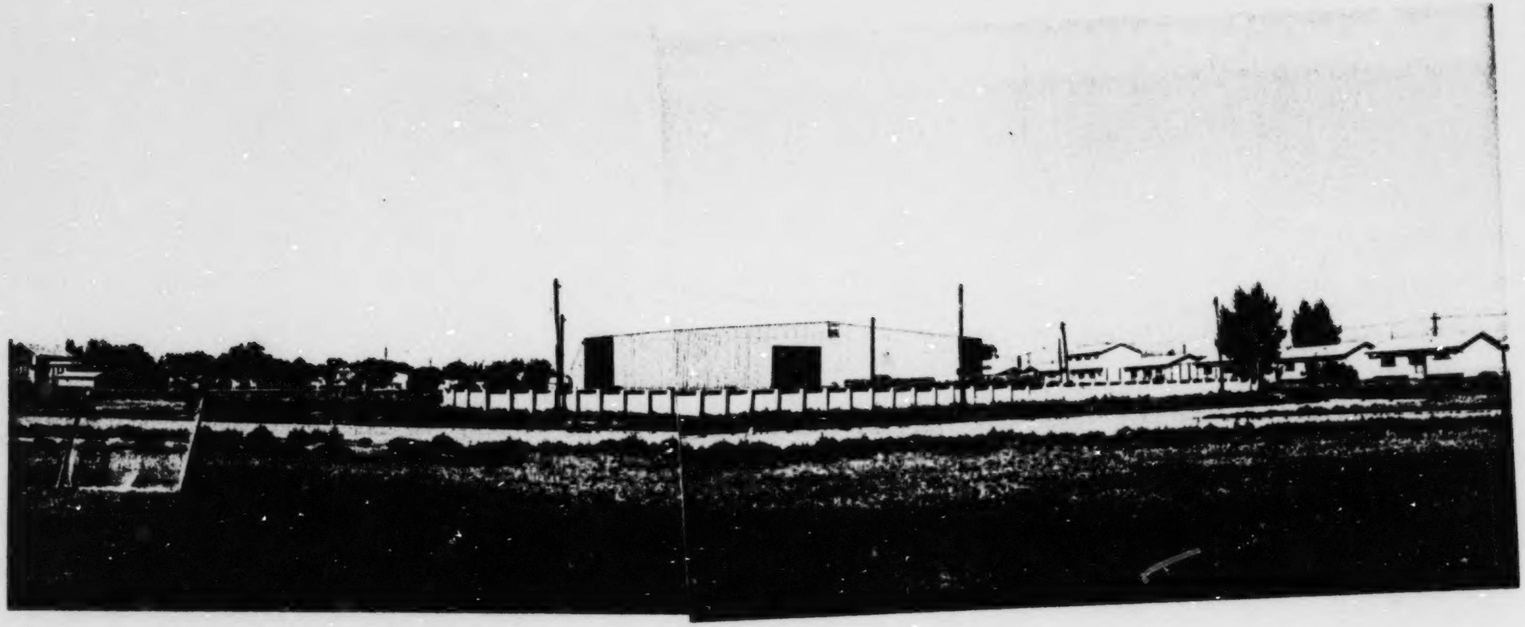
APPENDIX A



Date: August 18, 1983 Location: Neepawa, Salt Mine Waste Disposal

Orientation: Taken on the south side of the Yellowhead Center looking north.

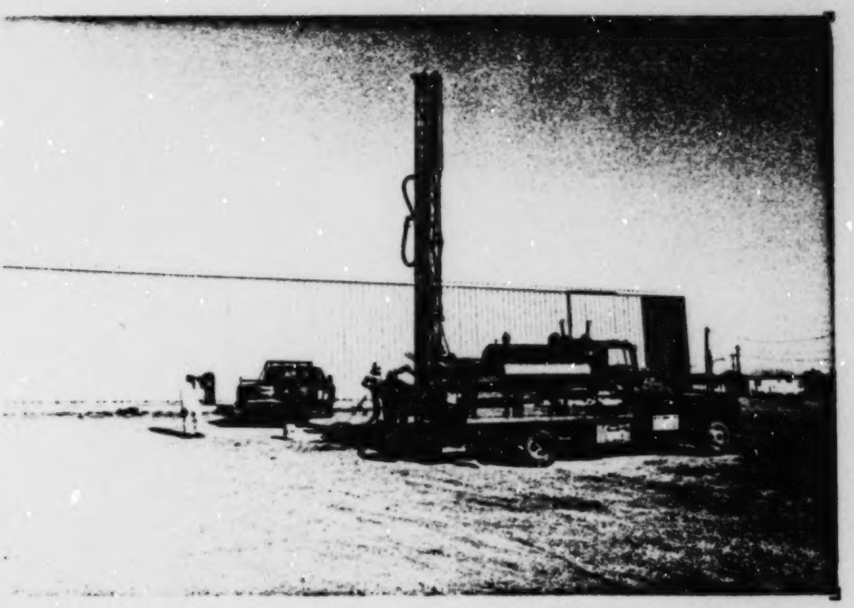
Comments: The long building to the right of the Yellowhead Center entrance is the indoor hockey arena. The building to the left of the entrance was once the Salt Mine bulk storage facility.



Date: August 18, 1983 Location: Neepawa, Salt Mine Waste Disposal

Orientation: Taken from the east end of the Yellowhead Center looking west.

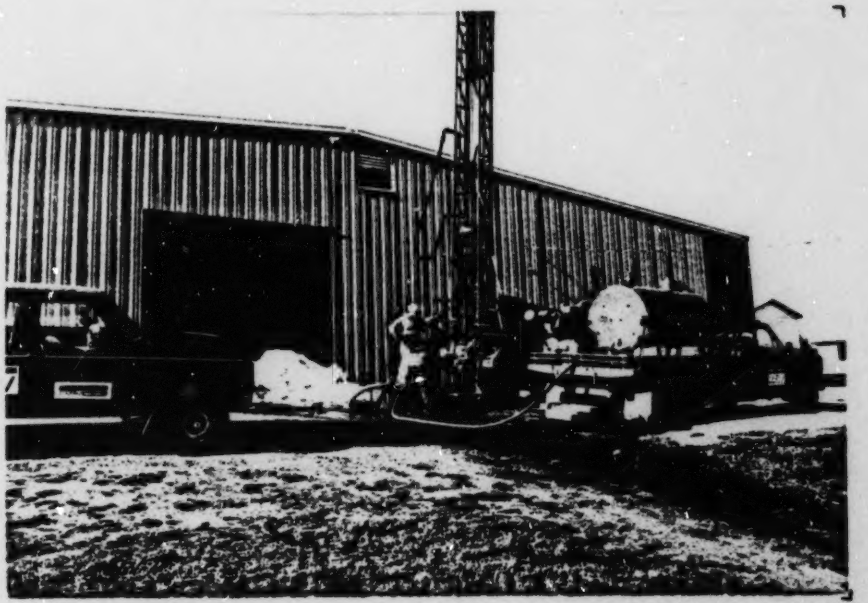
Comments: Disposal area believed to be beneath this end of the Yellowhead Center. May also extend under the outdoor ice rink seen in the center of this photograph.



Date: October 31, 1983 Location: Neepawa, Salt Mine Waste Disposal

Orientation: Taken on the south side of the Yellowhead Center looking NE.

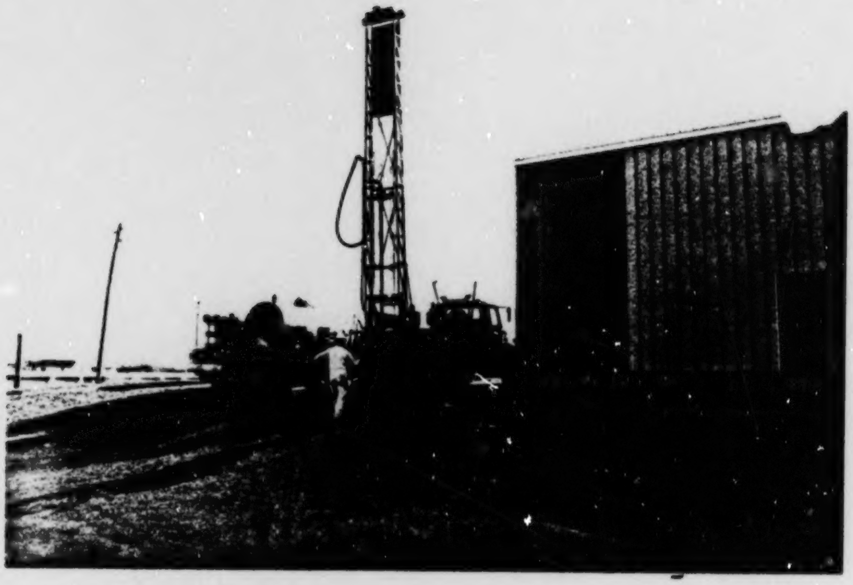
Comments: Drilling of test hole #1.



Date: October 31, 1983 Location: Neepawa, Salt Mine Waste Disposal

Orientation: Taken from the east end of the Yellowhead Center looking NW.

Comments: Drillimg of test hole #2.



Date: October 31, 1983 Location: Neepawa, Salt Mine Waste Disposal

Orientation: Taken on the north side of the Yellowhead Center looking SE.

Comments: Drilling of test hole #3.

APPENDIX B

FILE NO. 5.7.4.2.

WATER RESOURCES BRANCH

GROUNDWATER POLLUTION HAZARD APPRAISAL

POTENTIAL SOURCE OF POLLUTION	Waste Disposal Ground
LOCATION OF SOURCE	NW34-14-15W
OWNER OF SOURCE	R.M. of Langford, Neepawa

GEOLOGICAL CONDITIONS	SURFICIAL DEPOSITS	Up to 6 m of sand underlain by glacial till with a few lenses of sand and gravel. The total thickness of the surficial deposits is around 65 m.
	BEDROCK	Shale.

GROUNDWATER CONDITIONS	AQUIFERS	The surface sand deposits form the most common aquifers in the area. The lenses of sand and gravel form minor aquifers interbedded in the till.
	WELLS	All the wells reported in the vicinity draw water from the shallow sand aquifers.

POLLUTION HAZARD

Because the sand containing the shallow aquifers is exposed, aquifer pollution by leachates from the waste disposal ground is likely.

COMMENTS

Because groundwater flow in the shallow aquifers in this quarter is toward Whitemud River, the leachates are likely to pollute groundwater only in the area between the disposal ground and the River.

BY: ____________________ M. Rutulis, P. Eng. DATE: Dec. 7, 1983
GROUNDWATER GEOLOGIST

APPENDIX C

GEOLOGIC LOG

Test Hole Identification: Neepawa, T.H. #1

Location: Neepawa, Manitoba. R.M. of Langford

Legal Description: NW-34-14-15W

Date: October 31, 1983.

Time: 11:20 A.M. to 12:00 P.M.

Total Depth: 12 Metres

Type Of Casing: N/A

Type Of Screen: N/A

Depth	Description
0 to 2.4 m.	Fill; stones, sand, silt, oil, asphalt.
2.4 to 4.9 m.	Light brown clay, fairly tight.
4.9 to 7.6 m.	Dark gray - brown clay, very tight and sticky.
7.6 to 12 m.	Dark gray clay till, some stones and rocks.

GEOLOGIC LOG

Test Hole Identification: Neepawa T.H. #2

Location: Neepawa, Manitoba. R.M. of Langford.

Legal Description: NW-34-14-15W

Date: October 31, 1983

Time: 12:00 P.M. to 12:25 P.M.

Total Depth: 9.0 Metres

Type Of Casing: N/A

Type Of Screen: N/A

Depth	Description
0 to 1.5 m.	Fill; stones, sand, silt, oil, asphalt.
* 1.5 to 3.7 m.	Dark fine grained, silty. Unfamiliar.
3.7 to 4.6 m.	Light brown clay, fairly tight.
4.6 to 6.1 m.	Light brown clay grading to gray clay.
6.1 to 9.0 m.	Dark gray-brown clay till, some stones and light gravel.

* Sample submitted to Provincial Soil Testing Laboratory for analysis. Suspected brine pond, coal ash mixture.

GEOLOGIC LOG

Test Hole Identification: Neepawa. T.H. #3

Location: Neepawa. Manitoba. R.M. of Langford

Legal Description: NW-34-14-15W

Date: October 31, 1983

Time: 1:30 P.M. to 2:00 P.M.

Total Depth: 9.0 Metres

Type Of Casing: N/A

Type Of Screen: N/A

Depth	Description
0 to 2.1 m.	Medium grained brown sand, perfect sorting probably fill.
2.1 to 3.0 m.	Coarse grained brown sand.
3.0 to 4.6 m.	Light brown clay, small amount of coarse gravel.
4.6 to 6.1 m.	Tight dark clay, some large shale chips.
6.1 to 9.0 m.	Dark gray clay, some small gravel.

APPENDIX D

Detailed Soil Analysis

Project: Phase II, Landfill study.

Location: Neepawa, R.M. of Langford. NW-34-14-15W

Test Hole Number: 2

Depth: 1.5 to 3.7 meters.

Date: October 31, 1983.

Parameter	Result	Measured Unit
Conductivity	1.30	mmhos/cm
pH	8.20	units
Sulphate-sulphur	325.00	ppm
Chloride	6.90	meq/litre
BiCarbonate	8.60	meq/litre
Nitrate-nitrogen	0.20	ppm
Sodium	245.00	ppm
Calcium	95.00	ppm
Magnesium	30.00	ppm
Potassium	30.00	ppm
SAR	5.60	units

3.6

MARIAPOLIS WASTE DISPOSAL GROUND

SW-2-5-12W

R.M. OF LORNE #5

3.6 Mariapolis Waste Disposal Ground

3.6.1 Location

The community of Mariapolis, Manitoba is located within the Rural Municipality of Lorne, approximately 133 kilometres west of Winnipeg along P.T.H. 23. The waste disposal area is located about 276 kilometres south-west of the community and the legal description is SW-2-5-12W.

Figure A is a Rural Municipality map locating the study area and the Community of Mariapolis within the Rural Municipality of Lorne.

3.6.2 Physiography

This region is characterized by deep basin sedimentary deposits forming extensive lake plains. These sediments are deposited in a pro-glacial or glacial environment creating a discontinuous veneer reflecting the form of the underlying bedrock topography.

Very little relief can be observed in this area. Some small swampy lakes form in depressions in the landscape. These lakes may be classified as intermittent, they are not interconnected and are often dry. Regional drainage of the area is from west to east toward Swan Lake.

3.6.3 Site Conditions

During the site visit on August 15, 1983, a number of observations were made with regard to the Mariapolis waste disposal facility. Pictures taken during the site visit serve to illustrate

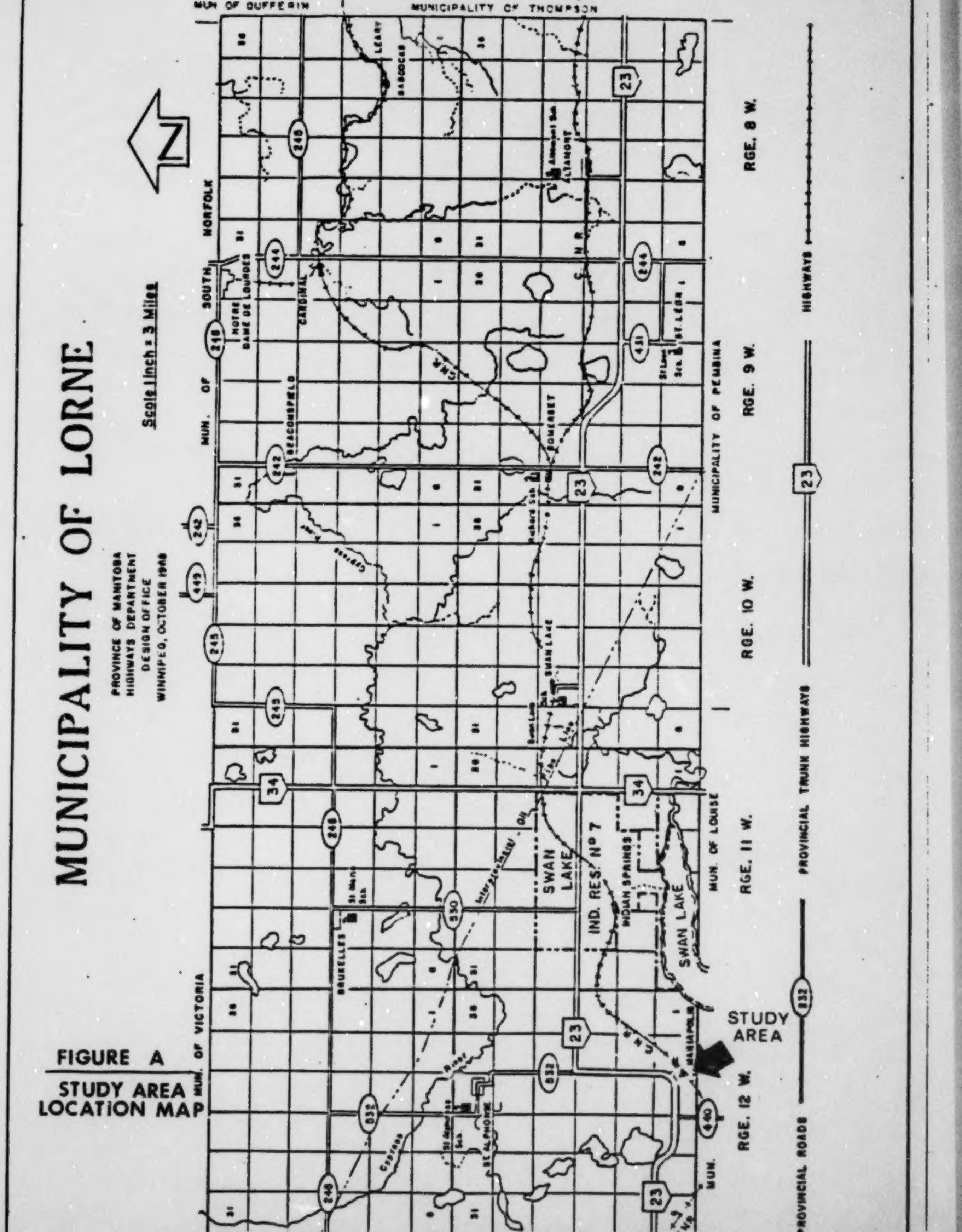

MUNICIPALITY OF LORNE
PROVINCE OF MANITOBA
HIGHWAYS DEPARTMENT
DESIGN OFFICE
WINNIPEG, OCTOBER 1968
Scale 1 inch = 3 Miles
N
N° 43
TP 6
TP 5
MUN. OF DUFFERIN
MUNICIPALITY OF THOMPSON
MUN. OF SOUTH NORFOLK
MUN. OF VICTORIA
MUNICIPALITY OF PEMBINA
MUN. OF LOUISE
RGE. 8 W.
RGE. 9 W.
RGE. 10 W.
RGE. 11 W.
RGE. 12 W.
LEARY
BABCOCKS
ALTAMONT
NOTRE DAME DE LOURDES
CARDINAL
BEACONSFIELD
SOMERSET
ST. LEON
SWAN LAKE
SWAN LAKE
IND. RES. N° 7
INDIAN SPRINGS
SWAN LAKE
BRUXELLES
ST. ALPHONSE
MARIAPOLIS
C.N.R.
C.P.R.
STUDY AREA
23
34
240
242
244
245
248
418
431
449
440
530
832
PROVINCIAL ROADS
PROVINCIAL TRUNK HIGHWAYS
HIGHWAYS

FIGURE A
STUDY AREA LOCATION MAP

the conditions in and around the inactive area of disposal. These pictures can be found in Appendix A, along with a detailed description of each view.

The disposal site covers an area of approximately 84 metres in length, (west to east), by 49 metres in width, (north to south). Access to the area is by a gravel road running south off St. Paul Street 125 metres east of P.T.H. 23.

From the information gathered during phase one of this study it was learned that various domestic and municipal wastes including, empty pesticide containers, were deposited at this disposal site. This waste disposal ground was closed in the fall of 1982. Surficial disposal and burial seems to have been the method of operation at this facility. All of the waste in the area was compacted and covered with earth. The cover material has been contoured to allow rain water and melt water to drain off. A fairly heavy grass cover can be found over most of the disposal area. The covered dump site reaches an elevation about 3 to 3.6 metres above grade. Figure B details the plan view of the site.

3.6.4 Surficial Geology and Hydrogeology

In general the surficial geology of the Mariapolis area can be directly related to a pro-glacial or glacial environment. Glaciolacustrine clay, silt, sand, and some minor gravel were deposited in pro-glacial lakes. These deep basin deposits range from 1 to 30 metres in thickness. Areas of iceberg scouring are common

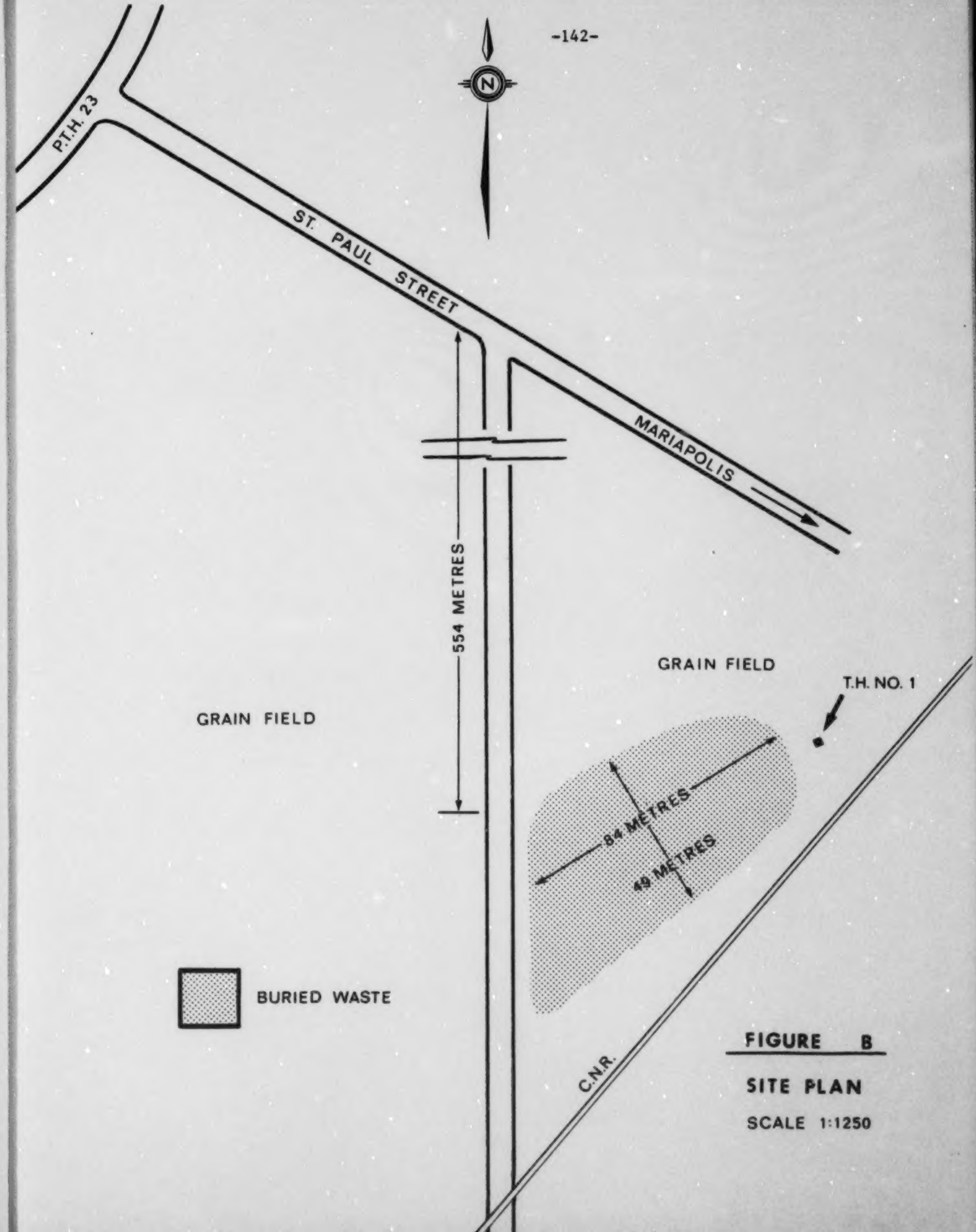

N
P.T.H. 23
ST. PAUL STREET
MARIAPOLIS
554 METRES
GRAIN FIELD
GRAIN FIELD
T.H. NO. 1
84 METRES
49 METRES
C.N.R.
BURIED WASTE

FIGURE B

SITE PLAN

SCALE 1:1250

with thin layers of alluvial deposits masking the underlying glacial debris. Wave washed till and exposed bedrock are also common in this setting. In the area directly around the disposal site, however, the glacial till is underlain by sand and gravel approximately 3.5 metres below ground level. The total thickness of these deposits ranges from 4.5 to 6 metres.

The bedrock in this region is hard shale with numerous fracture zones. This fractured shale along with the surficial sands and gravels form the most common aquifers in the area. Most of the domestic groundwater supplies in the Mariapolis area are drawn from the sand and gravel aquifers.

The Water Resources Branch, Department of Natural Resources, Province of Manitoba was requested to complete a groundwater pollution hazard appraisal for the Mariapolis waste disposal facility. A copy of this appraisal can be found in Appendix B. Basically the comments made on the appraisal agree with the above general geology. The disposal site is located in an area designated as a groundwater pollution hazard area because the sand and gravel aquifers common to this region are at or near ground surface at this particular location. A field investigation of the waste disposal site was suggested by the Water Resources Branch to confirm the geologic conditions directly below the landfill site. This approach agrees with the method of investigation formulated for this site after the initial site visit.

On November 8, 1983, one 12 metre deep test hole was drilled at the Mariapolis waste disposal site using the mud rotary drilling method. A monitoring well was installed in the test hole drilled.

T.H. #1 was drilled to 12 metres for geologic confirmation. Because of the lower till formation the 51 mm I.D. monitoring well was set to 7.6 metres, with the last 2.4 metres slotted and screened with fiberglass well screening material. A geologic log for the test hole drilled can be found in Appendix C. Soil samples taken during the test drilling program have been retained for future reference. The test hole location can be found on Figure B.

3.6.5 Groundwater Sampling

On November 10, 1983, and again on January 10, 1984, groundwater samples were collected from two residences, one 300 metres east, the second 451 metres north of the Mariapolis waste disposal grounds. A third groundwater sample was collected from the established monitoring well installed at the site. These samples were submitted to the W. M. Ward Technical Services Laboratory for analysis. Bacteriological samples were submitted to the Cadham Provincial Laboratory for testing. The results of these analyses can be found in Appendix D.

Figure C is an air photo at scale of 1:15840. This photo shows the location of the disposal site with respect to the Town of Mariapolis. The groundwater sampling points established during the field investigation of this waste disposal site have been located on this air photo.

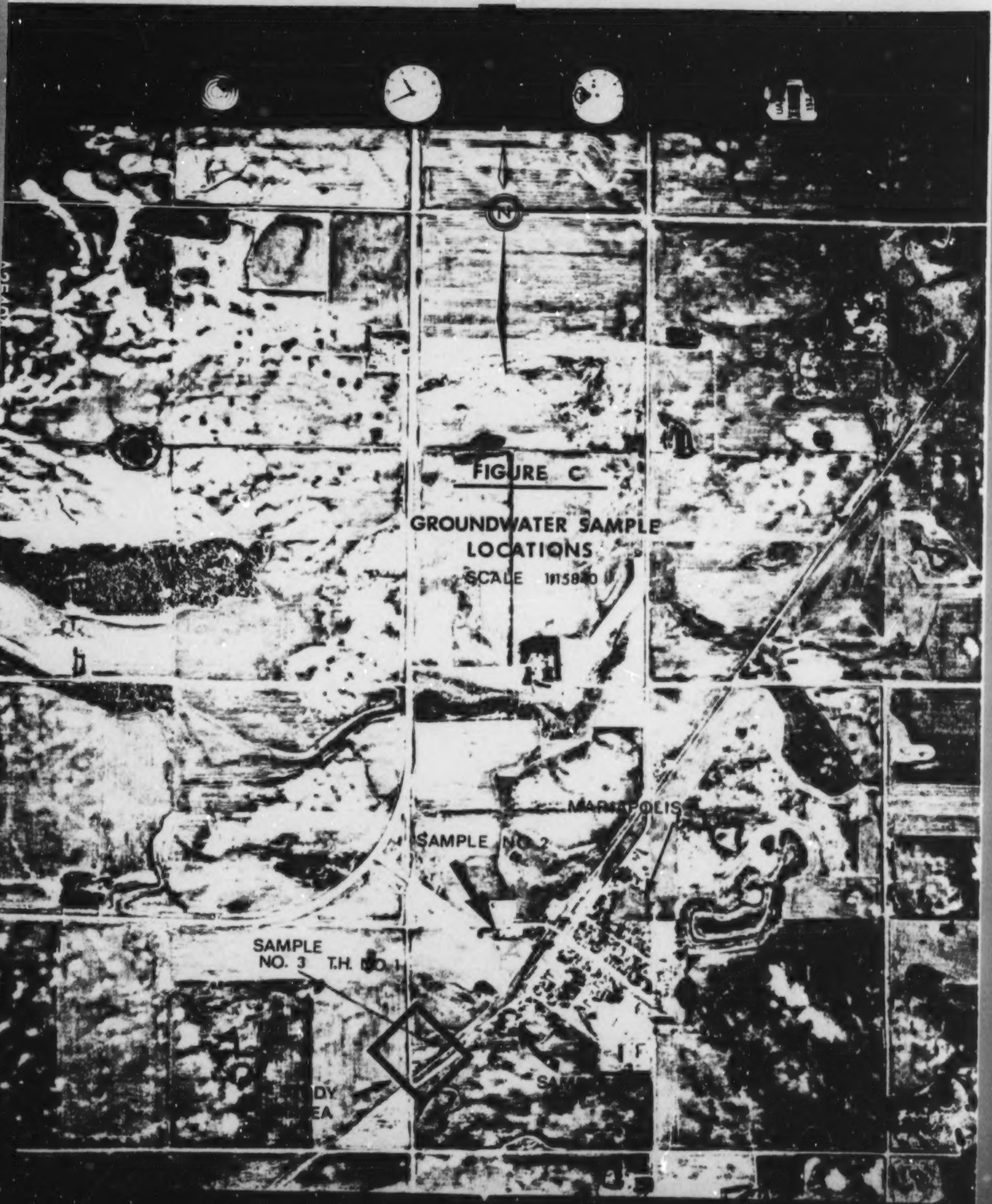


FIGURE C

GROUNDWATER SAMPLE LOCATIONS

SCALE 1:15840

N
MARIAPOLIS
SAMPLE NO. 2
SAMPLE
NO. 3
T.H. NO. 1
DY
EA
SAM

3.6.6 Analytical Results and Conclusions

With regard to the inactive Mariapolis waste disposal facility and the phase two assessment of the site, there is no observed effect on the surrounding environment. Data collected througout the study shows no hazard to the public health which can be directly attributed to the waste disposal ground.

Groundwater

Because the site is considered to be in a groundwater pollution hazard area, a test drilling program was established to identify the surficial geologic and hydrogeologic conditions directly in and around the site. Surficial depostion of waste as in this case, has left the upper sediments relatively intact. This means that approximately 3.5 metres of till material containing a large percentage of clay, underlies this particular waste disposal facility. This clay till acts as a barrier to downward leachate migration.

When the site was closed an earthen cap was compacted over the waste material. This cap allows rain water and melt water to run off the actual disposal area. Because precipitate water is not percolating through the waste, leachates are not being produced in great quantities. Any leachate which is produced may be held from reaching the underlying sand and gravel aquifer by the uppermost layers of clay till.

Water quality analysis conducted on the two domestic water supplies and the established monitoring well were compared to the "Guidelines for Canadian Drinking Water Quality" prepared by Health and Welfare Canada in 1978. These groundwater supplies can be described in general, as good quality for domestic purposes.

These test drilling observations and laboratory results indicate that groundwater contamination is not a problem with respect to the Mariapolis waste disposal facility. Further sampling of the domestic groundwater supplies in the area and the established monitoring well, on a periodic basis, is advisable to confirm that groundwater contamination is not occurring in the future.

Methane

Methane gas produced through the decomposition of buried domestic waste can be of concern to buildings located in close proximity to waste disposal sites. In this case, however, because of surficial soil conditions, the method of operation being above ground deposition of waste, and the distance to the nearest building, approximatley 276 metres, methane production and subsurface migration is not a concern.

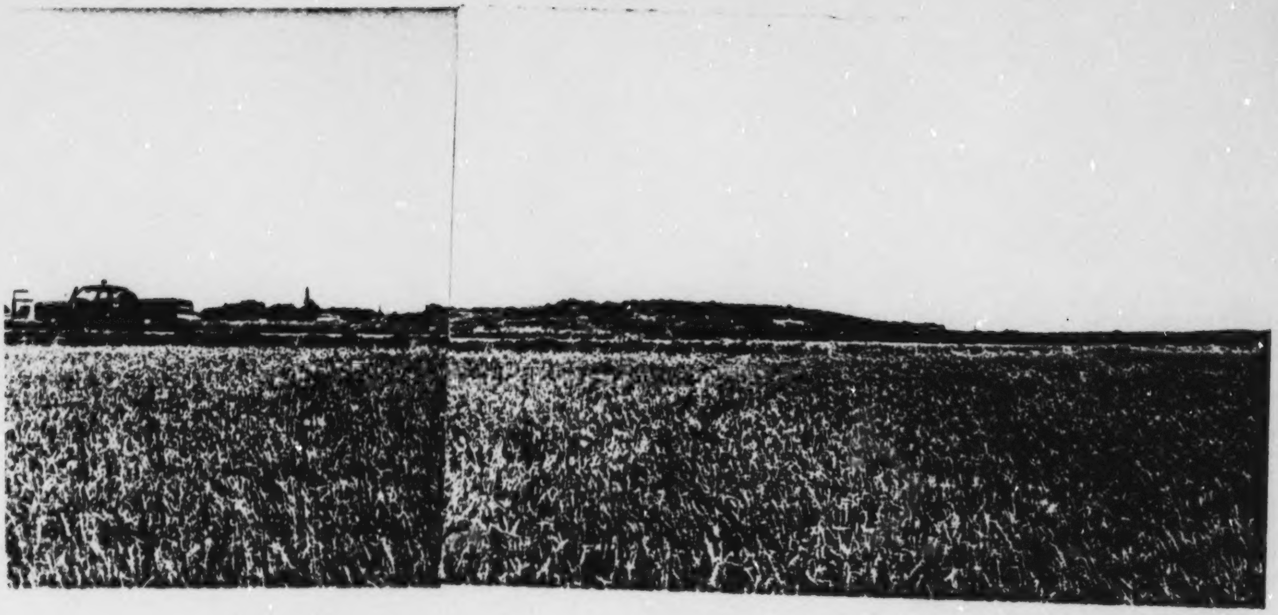
Surface Water

Surface water pollution from the waste disposal ground is not likely to occur at this particular site. Small intermittent lakes in the area are fairly shallow and swampy. These lakes form in surface depressions when seasonal runoff and precipitation is abundant. The nearest large body of water is Swan Lake over 2 kilometres east of the Mariapolis disposal site. Pollution of surface water by either surficial runoff or groundwater migration of leachates from the waste disposal ground is not going to occur because of the surficial soil characterisitics in and around the disposal site.

3.6.7 Recommendations

1. It is recommended that periodic collection of groundwater samples from local domestic groundwater supplies, and the monitoring well established for this study, be undertaken to confirm that groundwater contamination does not occur in the future.

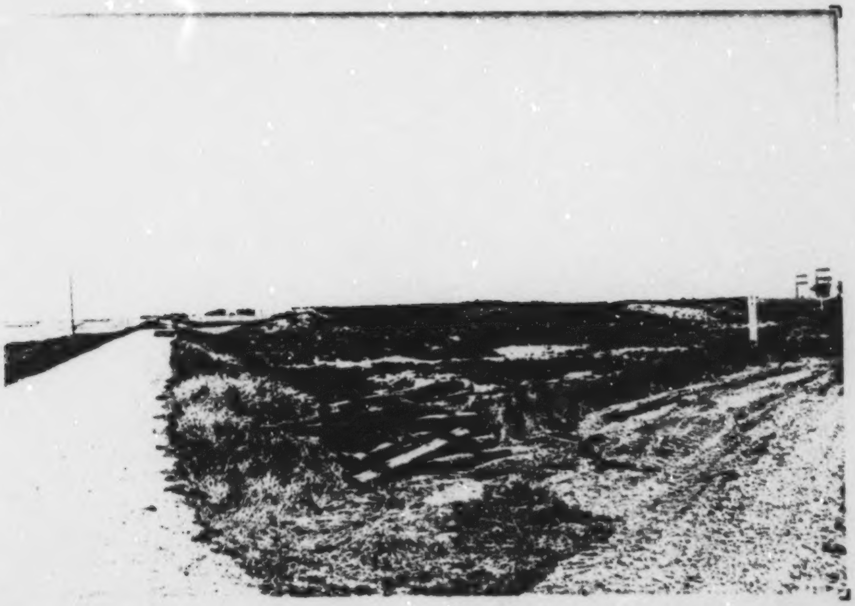
APPENDIX A



Date: August 15, 1983 Location: Mariapolis Waste Disposal Ground

Orientation: Taken from the west side of the disposal mound looking east.

Comments: The inactive waste disposal ground has been covered and a fairly good grass cover is evident. Note the site rises about 3.6 meters above grade.



Date: August 15, 1983 Location: Mariapolis Waste Disposal Ground

Orientation: Taken just to the south-west of the site looking north-east.

Comments: The disposal mound can be located in the center of this photograph just to the right of the truck. The elevators to the right of the picture are located in the town of Mariapolis.

Date: November 8, 1983 Location: Mariapolis Waste Disposal Ground

Orientation: Taken from the top of the disposal mound looking north-east.

Comments: Drilling of test hole #1. A monitoring well was installed at this location.

APPENDIX B

FILE NO. 5.7.4.2.

WATER RESOURCES BRANCH

GROUNDWATER POLLUTION HAZARD APPRAISAL

POTENTIAL SOURCE OF POLLUTION	Waste Disposal Ground
LOCATION OF SOURCE	SW2-5-12W
OWNER OF SOURCE	R.M. of Lorne, Mariapolis

GEOLOGICAL CONDITIONS	SURFICIAL DEPOSITS	The surface deposits consist of glacial till and sand and gravel. In some places the glacial till may be underlain by sand and gravel at less than 5 m below ground level. The total thickness of the surficial deposits ranges from 10 m to 20 m.
	BEDROCK	Shale, hard with fractured zones.

GROUNDWATER CONDITIONS	AQUIFERS	Both sand and gravel and fractured shale aquifers are common in the area.
	WELLS	Most of the wells reported in the vicinity are completed in the sand and gravel aquifers. A few wells draw water from the shale aquifers.

POLLUTION HAZARD

Because in some places the sand and gravel aquifers are at or near ground surface, groundwater pollution by leachates from a waste disposal ground is possible in some parts of the quarter section.

COMMENTS

A field investigation to assure that the disposal ground is not located over a shallow aquifer would be advisable.

BY: ____________ M. Rutulis, P. Eng.
GROUNDWATER GEOLOGIST

DATE: Dec. 7, 1983

APPENDIX C

GEOLOGIC LOG

Test Hole Identification: Mariapolis T.H. #1

Location: Mariapolis, Manitoba. R.M. of Lorne

Legal Description: SW-2-5-12W

Date: November 8, 1983

Time: 11:30 A.M. to 12:20 P.M.

Total Depth: 12 Metres

Type Of Casing: Series 160 plastic

Type Of Screen: Slotted, Fiberglass wrap

Depth	Description
0 to 3.0 m.	Brown clay till, some stones and sand.
3.0 to 4.6 m.	Brown sand, some clay and stones.
4.6 to 7.6 m.	Gray sand and gravel, shale about 15%.
7.6 to 9.1 m.	Gray clay till, some sand and gravel, some large pieces of shale.
9.1 to 10.6 m.	Gray clay with some small pieces of shale.
10.6 to 12 m.	Gray clay, shale about 50%.

APPENDIX D

Water Quality Analysis

Project: Phase II Landfill Study

Location: Mariapolis, R.M. of Lorne. NW-2-5-12W

Sample #: 1

Date: Result A; November 9, 1983 Result B; January 12, 1984

Parameter	Result A	Result B	Measured Unit
Conductivity	1200.00	1220.00	umho/cm
Residue Total	860.00	880.00	mg/l
Residue Filterable	860.00	880.00	mg/l
Residue Non Filterable	L 5.00	L 5.00	mg/l
pH	7.30	7.25	units
Alkalinity Total (CaCO3)	336.00	332.00	mg/l
Alkalinity (HCO3)	410.00	405.00	mg/l
Alkalinity (CO3)	0.00	0.00	mg/l
Alkalinity (OH)	0.00	0.00	mg/l
Arsenic, As	0.004	0.002	mg/l
Cadmium, Cd	L 0.001	L 0.001	mg/l
Copper, Cu	L 0.01	L 0.01	mg/l
Lead, Pb	L 0.005	L 0.005	mg/l
Zinc, Zn	0.12	0.09	mg/l
Chromium, Cr	L 0.005	L 0.005	mg/l
Calcium, Ca	152.00	139.00	mg/l
Magnesium, Mg	75.80	68.40	mg/l
Hardness (CaCO3)	692.00	629.00	mg/l
Manganese, Mn	0.68	0.68	mg/l
Iron, Fe	1.50	2.25	mg/l
Sodium, Na	44.60	38.50	mg/l
Color	-	-	units
Turbidity	9.00	10.00	NTU
Cyanide, CN	L 0.02	L 0.02	mg/l
NO3-NO2-N	L 0.01	L 0.01	mg/l
Chloride, Cl	60.00	58.00	mg/l
Sulphate, SO4	250.00	260.00	mg/l
Coliform Group	-	L 1.00	per 100 ml
Fecal Coliform	-	L 1.00	per 100 ml

L = Less Than

G = Greater Than

Water Quality Analysis

Project: Phase II Landfill Study

Location: Mariapolis, R.M. of Lorne. NW-2-5-12W

Sample #: 2

Date: Result A; November 9, 1983 Result B; January 12, 1984

Parameter	Result A	Result B	Measured Unit
Conductivity	1120.00	1010.00	umho/cm
Residue Total	850.00	740.00	mg/l
Residue Filterable	850.00	740.00	mg/l
Residue Non Filterable	7.00	L 5.00	mg/l
pH	7.45	7.40	units
Alkalinity Total (CaCO3)	274.00	276.00	mg/l
Alkalinity (HCO3)	334.00	361.00	mg/l
Alkalinity (CO3)	0.00	0.00	mg/l
Alkalinity (OH)	0.00	0.00	mg/l
Arsenic, As	L 0.001	L 0.001	mg/l
Cadmium, Cd	0.012	L 0.001	mg/l
Copper, Cu	0.02	L 0.01	mg/l
Lead, Pb	0.008	L 0.005	mg/l
Zinc, Zn	1.35	0.02	mg/l
Chromium, Cr	L 0.005	L 0.005	mg/l
Calcium, Ca	137.00	131.00	mg/l
Magnesium, Mg	60.30	56.00	mg/l
Hardness (CaCO3)	591.00	558.00	mg/l
Manganese, Mn	0.52	0.91	mg/l
Iron, Fe	19.40	1.02	mg/l
Sodium, Na	5.82	5.58	mg/l
Color	-	-	units
Turbidity	8.00	2.50	NTU
Cyanide, CN	L 0.02	L 0.02	mg/l
NO3-NO2-N	L 0.01	L 0.01	mg/l
Chloride, Cl	50.00	36.00	mg/l
Sulphate, SO4	270.00	205.00	mg/l
Coliform Group	-	L 1.00	per 100 ml
Fecal Coliform	-	L 1.00	per 100 ml

L = Less Than

G = Greater Than

Water Quality Analysis

Project: Phase II Landfill Study

Location: Mariapolis, R.M. of Lorne. SW-2-5-12W

Sample #: 3

Date: Result A; November 9, 1983 Result B; January 12,1983

Parameter	Result A	Result B	Measured Unit
Conductivity	1170.00	1090.00	umho/cm
Residue Total	2444.00	-	mg/l
Residue Filterable	850.00	780.00	mg/l
Residue Non Filterable	590.00	-	mg/l
pH	7.95	7.40	units
Alkalinity Total (CaCO3)	368.00	356.00	mg/l
Alkalinity (HCO3)	449.00	434.00	mg/l
Alkalinity (CO3)	0.00	0.00	mg/l
Alkalinity (OH)	0.00	0.00	mg/l
Arsenic, As	0.012	0.001	mg/l
Cadmium, Cd	0.001	0.002	mg/l
Copper, Cu	0.05	0.17	mg/l
Lead, Pb	0.006	0.005	mg/l
Zinc, Zn	0.13	0.10	mg/l
Chromium, Cr	0.053	L 0.005	mg/l
Calcium, Ca	180.00	136.00	mg/l
Magnesium, Mg	64.60	50.00	mg/l
Hardness (CaCO3)	716.00	546.00	mg/l
Manganese, Mn	1.18	0.52	mg/l
Iron, Fe	3.77	0.11	mg/l
Sodium, Na	78.30	51.00	mg/l
Color	5.00	-	units
Turbidity	300.00	-	NTU
Cyanide, CN	L 0.03	-	mg/l
NO3-NO2-N	0.02	0.01	mg/l
Chloride, Cl	13.00	13.00	mg/l
Sulphate, SO4	285.00	260.00	mg/l
Coliform Group	-	L 1.00	per 100 ml
Fecal Coliform	-	L 1.00	per 100 ml

L = Less Than

G = Greater Than

3.7

MINIOTA WASTE DISPOSAL GROUND

NE-25-13-27W

R.M. OF MINIOTA #1

3.7 Miniota Waste Disposal Ground

3.7.1 Location

The community of Miniota, Manitoba is located within the Rural Municipality of Miniota, approximately 265 kilometres west of Winnipeg along P.T.H. 83. The waste disposal area is located about 652 metres south-west of the Community and the legal discription is NE-25-13-27W.

Figure A is a Rural Municipality Map locating the study area and the Community of Miniota within the Rural Municipality of Miniota.

3.7.2 Physiography

This region is characterized by the steep valley walls of the Assiniboine River Valley. This particular disposal site is located on the valley's eastern bluff overlooking the Assiniboine River. West of the site extensive prairie showing very little relief is common.

Surficial drainage for this area is down the valley toward the Assiniboine River. Some small drainage channels are evident running down the slopes of the valley, but these would only be active in times of high surficial runoff, such as, spring thaw or during very high rains. Regional drainage for the area is from east to west.

3.7.3 Site Conditions

During the site visit on August 19, 1983, a number of observations were made with regard to the Miniota waste disposal

Nº 53

MUNICIPALITY OF MINIOTA

PROVINCE OF MANITOBA
HIGHWAYS DEPARTMENT
DESIGN OFFICE
WINNIPEG, DECEMBER 1968

Scale 1 inch = 3 miles

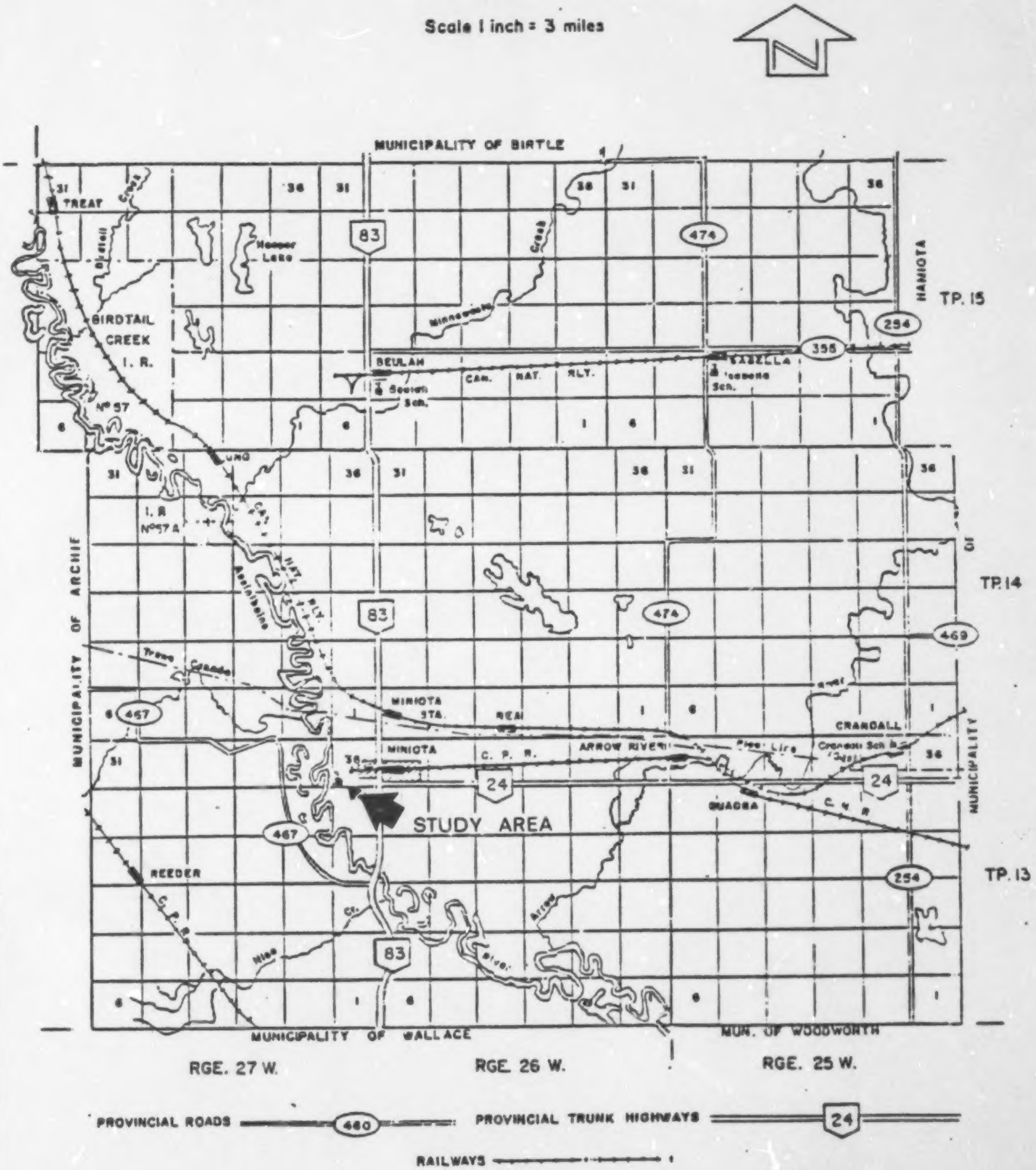

N
MUNICIPALITY OF BIRTLE
TREAT
Hooper Lake
Birdtail Creek
Minnewashta Creek
83
474
254
355
BIRDTAIL CREEK I. R. Nº 57
BEULAH
Beaton Sch.
CAN. NAT. RLY.
ISABELLA
Isabella Sch.
HAMIOTA
TP. 15
LUND
I. R. Nº 57 A
Assiniboine
TP. 14
469
MUNICIPALITY OF ARCHIE
467
MINIOTA STA.
NEAI
CRANDALL
MINIOTA
C. P. R.
ARROW RIVER
Pipe Line
24
QUADRA
C. P. R.
STUDY AREA
MUNICIPALITY
TP. 13
REEDER
Arrow River
MUNICIPALITY OF WALLACE
MUN. OF WOODWORTH
RGE. 27 W.
RGE. 26 W.
RGE. 25 W.
PROVINCIAL ROADS
460
PROVINCIAL TRUNK HIGHWAYS
24
RAILWAYS

FIGURE A

STUDY AREA
LOCATION MAP

facility. Pictures taken during the site visit serve to illustrate the conditions in and around the active area of disposal. These pictures can be found in Appendix A, along with a detailed description of each view.

The disposal site covers an area of approximately 89 metres in length, (east to west), by 36 metres in width, (north to south). This area is not fenced but some tree cover is present around the site. Access to the area is by a gravel road 252 metres south of Miniota running west off P.T.H. 83. There are no signs at the site indicating disposal procedures except for a small wooden placard indicating an area for "spray cans" disposal.

The active disposal area is a pit 65 metres long by 16 metres wide and approximately 2 metres deep. From the information gathered in phase one of this study it was learned that various types of municipal and domestic wastes are disposed of at this site.

While at the site it was observed that pesticide containers were collected and stored about 18 metres west of the active disposal area. These cans have been crushed since the initial site visit and await disposal. Burning of the waste in the disposal trench was ongoing and unsupervised. A separate section of the disposal facility has been reserved for bulky metals, that is, stoves, car bodies, etc. The site itself is well kept with little or no litter outside of the active area of disposal. Figure B details the plan view of the site.

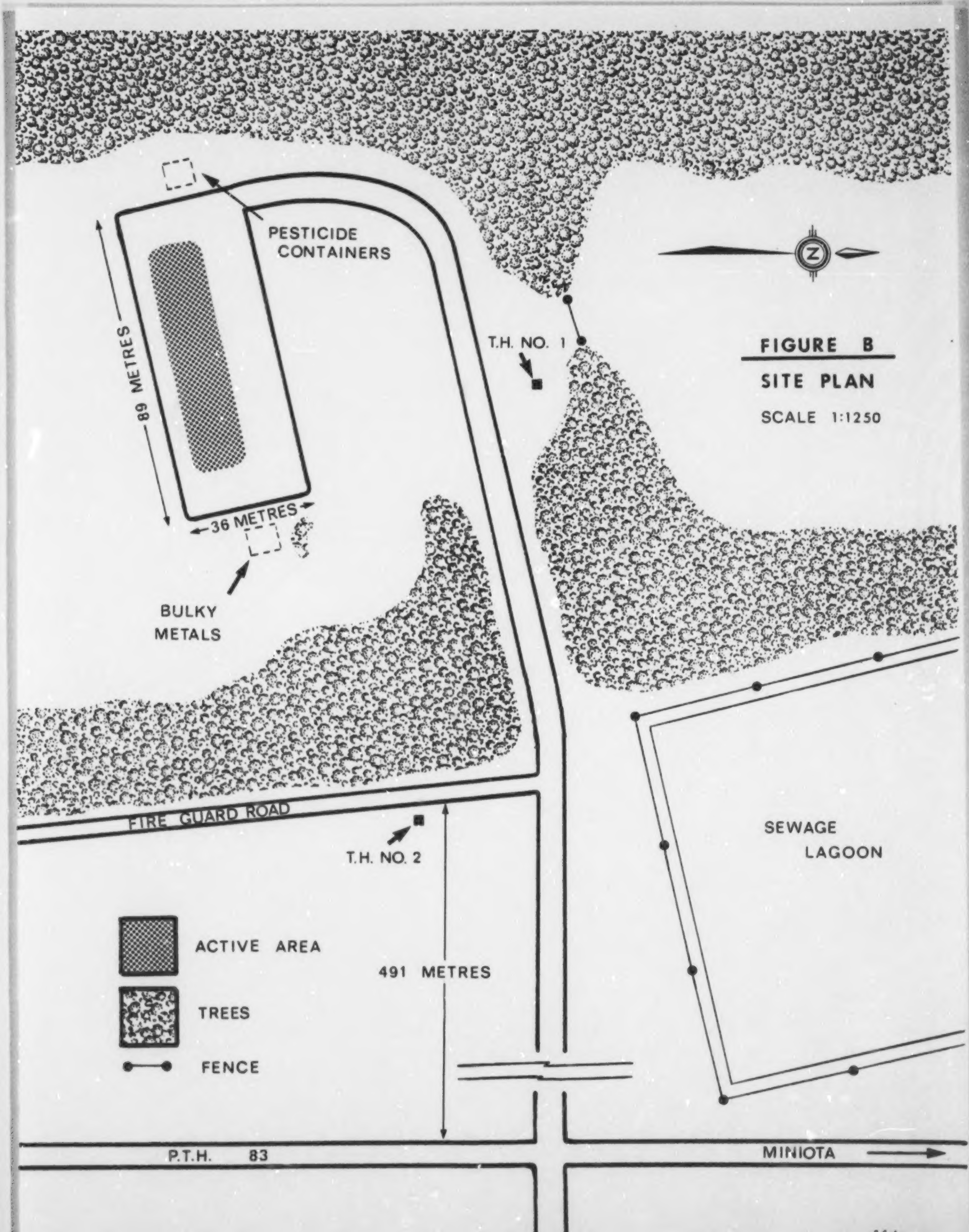


FIGURE B

SITE PLAN

SCALE 1:1250

PESTICIDE CONTAINERS
89 METRES
36 METRES
BULKY METALS
T.H. NO. 1
Z
FIRE GUARD ROAD
T.H. NO. 2
ACTIVE AREA
TREES
FENCE
491 METRES
SEWAGE LAGOON
P.T.H. 83
MINIOTA

3.7.4 Surficial Geology and Hydrogeology

In general the surficial geology around the Miniota waste disposal ground can be directly related to a non glacial environment. Glacial till 1 to 30 metres thick, made up of sand, silt, gravel and clay is common. These alluvial sediments have been deposited in what can be described as a glacial spillway, which has now become the Assiniboine River valley. Often the till is overlain by substantial sand and gravel deposits. Where the till is not overlain by sand and gravel, interbedded sand and gravel lenses may be encountered within the body of the till.

The bedrock in the area is commonly soft shale. Very little fracturing occurs in the upper shale and therefore groundwater movement through the shale is minimal. The surficial sand and gravel is the most common source of groundwater in this region, with localized aquifers found in the interbedded sand and gravel lenses. Most of the domestic water supplies in the Miniota area are drawn from the surficial deposits.

The Water Resources Branch, Department of Natural Resources, Province of Manitoba was requested to complete a groundwater pollution hazard appraisal for the Miniota waste disposal facility. A copy of this appraisal can be found in Appendix B. Basically the comments made on the appraisal agree with the above general geology. This disposal site is not located in a groundwater pollution hazard area. Because shallow surficial sand and gravel aquifers are expected to extend into the area in and around the disposal facility, a field investigation was formulated for this site to confirm the geologic conditions in the vacinity of the disposal area.

On November 2, 1983, two test holes were drilled at the Miniota waste disposal site using the mud rotary drilling method. Monitoring wells were installed in the two test holes. T.H. #1 was drilled to 12 metres for geologic confirmation. Because of the lower clay till formation, the 51 mm. I.D. monitoring well was set to 4.8 metres, with the last 1.8 metres slotted and warapped with fiberglass well screening material. T.H. #2 was drilled to 9 metres for geologic confirmation. In this case the 51 mm. I.D. monitoring well was set to 4.6 metres with the last 1.8 metres slotted and wrapped with fiberglass well screening material. Geologic logs for the holes drilled can be found in Appendix C. Soil samples taken during the test drilling program have been retained for future reference. Test hole locations can be found on Figure B.

3.7.5 Groundwater Sampling

On November 2, 1983, and again on January 12, 1984, groundwater samples were collected from 2 residences, one municipal well, and the two installed monitoring wells. These samples were submitted to the W. M. Ward Technical Services Laboratory for analysis. Bacteriological samples were submitted to the Cadham Provincial Laboratory for testing. The results of these analyses can be found in Appendix D.

Figure C is an air photo of the study area at a scale of 1:15840. This photo shows the location of the disposal site with respect to the Community of Miniota. The groundwater sampling locations established during the field investigation of this waste disposal site have been located on this air photo.

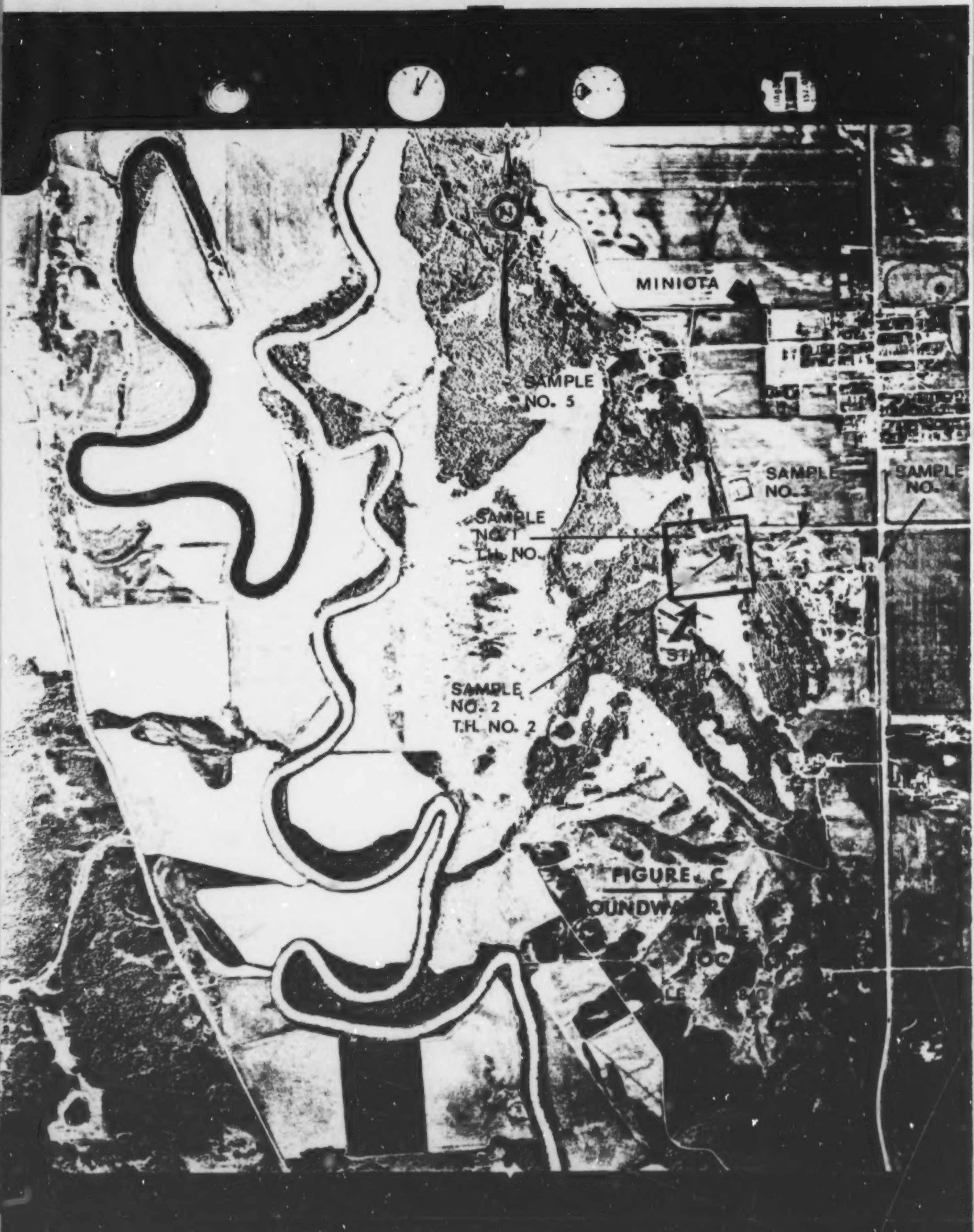

N
MINIOTA
SAMPLE NO. 5
SAMPLE NO. 3
SAMPLE NO.
SAMPLE NO. 1 T.H. NO.
STUDY
SAMPLE NO. 2 T.H. NO. 2

FIGURE C

GROUNDWATER SAMPLE LOCATION

SCALE [illegible]

3.7.6 Analytical Results and Conclusions

With regard to the Miniota waste disposal facility and the phase two assessment of the site, some environmental damage may have been caused by leachate from the disposal site getting into the underlying sand and gravel aquifer. Because of the proximity of the Miniota sewage lagoon to the study area, contamination of the sand and gravel aquifer by this lagoon is also suspected. Data collected throughout the study indicates however, that the domestic water supplies amd the community well are not effected by this particular problem.

Groundwater

Because of the surficial sand and gravel aquifer expected to be underlying the waste disposal facility, a test drilling program was established to identify the surficial geologic and hydrogeologic conditions in and around the site. From information gathered from the two test holes drilled, and the exposed sand and gravel east of the disposal area and at the base of the sewage lagoon, it would seem that the Miniota waste disposal ground is located on a fairly permeable surficial sand and gravel deposit. This deposit seems to be uniform in thickness and covers an extensive area. Below the sand and gravel layer is a course till material high in clay content. This material is considered to be relatively impermeable and acts to confine downward leachate migration and groundwater movement. Groundwater flow in the area would be from east to west toward the Assiniboine River Valley.

Water quality analyses conducted on the two domestic water supplies, the community well, and the two established monitoring wells were compared to the "Guidelines for Canadian Drinking Water Quality" prepared by Health and Welfare Canada in 1978. Samples #4 and #5, both domestic water supplies and sample #3, a community well east of the disposal facility, can be described in general as good quality for domestic purposes. The only parameters of health significance were the nitrate count of sample #4 which on both occasions sampled, was above the maximum acceptable limit, and the nitrate count of sample #3 which was slightly above the acceptable limit when sampled in January of 1984. These results cannot be attributed to the waste disposal ground.

Results from the monitoring wells, samples #1 and #2 indicate some environmental damage has been done to the surficial sand and gravel aquifer underlying the area around the Miniota waste disposal ground. It is suspected that a great deal of this problem has been caused by a complete leakage of sewage lagoon effluent to the underlying groundwater aquifer. The Miniota sewage lagoon has been constructed in the water bearing surficial sands and gravels and does not hold liquid.

The active disposal pit is approximately 2 metres in depth and it may also intersect the surficial sands and gravels. Any leachate from the disposal area would only contribute to the already contaminated state of the groundwater in the vacinity of the disposal site and sewage lagoon.

Groundwater flow is westward toward the Assiniboine River. This is supported by the water quality analysis of the sample points west of the monitoring wells, which are in the same surficial aquifer but do not show the same indications of groundwater contamination.

Methane

Methane gas produced through the decomposition of buried domestic wastes can be of concern to buildings located in close proximity to waste disposal sites. Methane gas migration, in this case, is possible through the surficial sands and gravels. However, because the distance to the nearest building is 576 metres methane production if any is not a concern.

It should be noted that exposimeter tests for methane gas were conducted during the test drilling program and at each sampling of the monitoring wells and no positive readings were recorded.

Surface Water

Surface water contamination if any, can not be directly attributed to the Miniota waste disposal facility. The Assiniboine River lies 978 metres west of the waste disposal ground. With ideal soil conditions, over this distance, surface water pollution would not be of concern.

Through research of Environmental Management Division files, calculations indicate that over 90,000 litres of effluent pass into the Miniota sewage lagoon each day. This effluent leaks directly to the surficial sands and gravels below the lagoon. Indications from our sampling program indicates contaminated groundwater exists south-west of the lagoon.

Although the hydraulic connection between the groundwater aquifer and the Assiniboine River has not been proven in this particular study, with groundwater movement in a westerly direction and the fairly steep grade down to the Assiniboine River, the contaminated groundwater would probably reach the river within a short period of time.

To prove any connection between the Assiniboine River and the contaminated groundwater aquifer underlying the Miniota sewage lagoon and waste disposal ground, further field work would have to be undertaken. Sampling of the river upstream and downstream of the site and the installation of one or two more monitoring wells would be required.

3.7.7 Recommendations

1) Pesticide and biocide containers which are stored in a separate area away from the active area of disposal have been crushed. These containers should be collected and disposed of in an approved manor.
2) Consideration should be given to locating a new disposal facility in an area where groundwater pollution will not occur. A site should be selected with at least 1.5 metres of impermeable clay like material between the bottom of the active area and any underlying groundwater aquifer.

3) Consideration should be given to relocating the sewage lagoon to an area where soil conditions are more suitable for liquid retention. An alternative to this is to line the sewage lagoon with a material which will aid in liquid retention and arrest contamination of the surrounding surficial sand and gravel aquifer.

4) Refer to Manitoba Regulation 208/76 under the Clean Environment Act for further clarification of these recommendations and other waste disposal ground operating procedures.

APPENDIX A

Date: August 19, 1983 Location: Miniota Waste Disposal Ground

Orientation: Taken from the west end of the disposal pit looking east.

Comments: The area around the site is fairly well kept. Burning of the waste is ongoing at this site. Note that at the time of this site visit no water was visible in the active area.

Date: August 19, 1983 Location: Miniota Waste Disposal Ground

Orientation: Taken from the east end of the disposal pit looking west.

Comments: Pesticide cans were not found in the active area. The soil at the base of the active pit was fairly moist.

Date: August 19. 1983 Location: Miniota Waste Disposal Ground

Orientation: Taken from the west end of the disposal area looking west.

Comments: Pesticide containment area. Sign to the right of the picture indicates "spray cans" disposal area. This area is not enclosed by any kind of fence.

Date: January 12, 1984 Location: Miniota Waste Disposal Ground

Orientation: Taken from the west end of the disposal area looking west.

Comments: Note that all of the cans have been crushed. Some are used for target practice and can be seen in the uper left of the photograph.

Date: November 2, 1983 Location: Miniota Waste Disposal Ground

Orientation: Taken from north of test hole #2 looking south.

Comments: Drilling of test hole #2. A monitoring well was installed at this site.

Date: November 2, 1983 Location: Miniota Waste Disposal Ground

Orientation: Taken from west of test hole #2 looking east.

Comments: This view shows the protective steel casing around the monitoring well.

Date: August 19, 1983 Location: Miniota Waste Disposal Ground

Orientation: Taken from the east end of the disposal area looking east.

Comments: The bulky metals disposal area is kept well seperated from the active area.

APPENDIX B

WATER RESOURCES BRANCH

FILE NO. 5.7.4.2.

GROUNDWATER POLLUTION HAZARD APPRAISAL

POTENTIAL SOURCE OF POLLUTION	Waste Disposal Ground
LOCATION OF SOURCE	NE25-13-27W
OWNER OF SOURCE	R.M. of Miniota, Miniota

GEOLOGICAL CONDITIONS	SURFICIAL DEPOSITS	In general the surficial deposits consist of glacial till with some lenses of sand and gravel. In some places, however, the till is overlain by sand and gravel. The total thickness of the surficial deposits ranges from 5 m to more than 20 m.
	BEDROCK	Shale.

GROUNDWATER CONDITIONS	AQUIFERS	The sand and gravel at surface and interbedded in the till constitutes the most common aquifers in the area. Groundwater movement in the sand and gravel aquifers likely is southwesterly toward Assiniboine River.
	WELLS	No wells have been reported in the immediate vicinity.

POLLUTION HAZARD

Leachates from the waste disposal ground may affect water quality in shallow aquifers downhill from the disposal area.

COMMENTS

If there are no wells downhill from the disposal ground, well pollution problems are not likely.

BY: M. Rutulis, P. Eng.
GROUNDWATER GEOLOGIST

DATE: Dec. 7/83

APPENDIX C

GEOLOGIC LOG

Test Hole Identification: Miniota, T.H. #1

Location: Miniota, Manitoba, R.M. of Miniota

Legal Description: NE-25-13-27W

Date: November 2, 1983

Time: 2:15 P.M. to 3:45 P.M.

Total Depth: 12 metres

Type Of Casing: Series 160 plastic

Type Of Screen: Slotted, Fiberglass wrap

Depth	Description
0 to .9 m.	Top soil and organics.
.9 to 4.6 m.	Coarse gravel and sand.
4.6 to 9.1 m.	Dark gray clay till, some sand and gravel, bentonite layer at 8.5 to 8.8 meters.
9.1 to 10.6 m.	Dark gray clay, few stones and little sand.
10.6 to 12 m.	Dark gray clay, soft shale.

GEOLOGIC LOG

Test Hole Identification: Miniota T.H. #2

Location: Miniota, Manitoba, R.M. of Miniota.

Legal Description: NE-25-13-27W

Date: November 2, 1983

Time: 4:15 P.M. to 6:00 P.M.

Total Depth: 9 Metres

Type Of Casing: Series 160 plastic

Type Of Screen: Slotted, Fiberglass wrap

Depth	Description
0 to .6 m.	Top soil and organics.
.6 to 4.0 m.	Coarse sand.
4.0 to 4.6 m.	Coarse sand grading into heavy gray till.
4.6 to 9 m.	Heavy gray till, lots of coarse sand and light gravel.

APPENDIX D

Water Quality Analysis

Project: Phase II Landfill Study

Location: Miniota, R.M. of Miniota. NE-25-13-27W

Sample #: 1

Date: Result A; November 4, 1983 Result B; January 12, 1984

Parameter	Result A	Result B	Measured Unit
Conductivity	1530.00	1610.00	umho/cm
Residue Total	-	-	mg/l
Residue Filterable	-	1000.00	mg/l
Residue Non Filterable	-	-	mg/l
pH	7.50	7.45	units
Alkalinity Total (CaCO3)	450.00	480.00	mg/l
Alkalinity (HCO3)	549.00	586.00	mg/l
Alkalinity (CO3)	0.00	0.00	mg/l
Alkalinity (OH)	0.00	0.00	mg/l
Arsenic, As	L 0.001	0.001	mg/l
Cadmium, Cd	L 0.001	L 0.001	mg/l
Copper, Cu	0.02	0.02	mg/l
Lead, Pb	L 0.005	L 0.005	mg/l
Zinc, Zn	0.04	0.03	mg/l
Chromium, Cr	L 0.005	0.008	mg/l
Calcium, Ca	122.00	131.00	mg/l
Magnesium, Mg	41.70	43.00	mg/l
Hardness (CaCO3)	477.00	504.00	mg/l
Manganese, Mn	0.03	0.03	mg/l
Iron, Fe	0.59	0.05	mg/l
Sodium, Na	179.00	177.00	mg/l
Color	-	-	units
Turbidity	-	-	NTU
Cyanide, CN	-	-	mg/l
NO3-NO2-N	6.80	5.80	mg/l
Chloride, Cl	148.00	176.00	mg/l
Sulphate, SO4	140.00	130.00	mg/l
Coliform Group	-	33.00	per 100 ml
Fecal Coliform	-	13.00	per 100 ml

L = Less Than

G = Greater Than

Water Quality Analysis

Project: Phase II Landfill Study

Location: Miniota, R.M. of Miniota. NE-25-13-27W

Sample #: 2

Date: Result A; November 4, 1983 Result B; January 12, 1984

Parameter	Result A	Result B	Measured Unit
Conductivity	1130.00	1240.00	umho/cm
Residue Total	-	-	mg/l
Residue Filterable	-	770.00	mg/l
Residue Non Filterable	-	-	mg/l
pH	7.95	7.55	units
Alkalinity Total (CaCO3)	316.00	354.00	mg/l
Alkalinity (HCO3)	386.00	432.00	mg/l
Alkalinity (CO3)	0.00	0.00	mg/l
Alkalinity (OH)	0.00	0.00	mg/l
Arsenic, As	L 0.001	L 0.001	mg/l
Cadmium, Cd	L 0.001	L 0.001	mg/l
Copper, Cu	0.04	0.02	mg/l
Lead, Pb	L 0.005	L 0.005	mg/l
Zinc, Zn	0.04	0.03	mg/l
Chromium, Cr	L 0.005	L 0.005	mg/l
Calcium, Ca	106.00	126.00	mg/l
Magnesium, Mg	37.60	42.40	mg/l
Hardness (CaCO3)	420.00	490.00	mg/l
Manganese, Mn	0.04	0.04	mg/l
Iron, Fe	0.87	0.11	mg/l
Sodium, Na	111.00	89.00	mg/l
Color	-	-	units
Turbidity	-	-	NTU
Cyanide, CN	-	-	mg/l
NO3-NO2-N	7.20	5.80	mg/l
Chloride, Cl	90.00	122.00	mg/l
Sulphate, SO4	145.00	120.00	mg/l
Coliform Group	-	L 1.00	per 100 ml
Fecal Coliform	-	L 1.00	per 100 ml

L = Less Than

G = Greater Than

Water Quality Analysis

Project: Phase II Landfill Study

Location: Miniota, R.M. of Miniota. NE-25-13-27W

Sample #: 3

Date: Result A; November 4, 1983 Result B; January 12, 1984

Parameter	Result A	Result B	Measured Unit
Conductivity	501.00	506.00	umho/cm
Residue Total	310.00	360.00	mg/l
Residue Filterable	310.00	360.00	mg/l
Residue Non Filterable	L 5.00	L 5.00	mg/l
pH	7.70	7.75	units
Alkalinity Total (CaCO3)	198.00	196.00	mg/l
Alkalinity (HCO3)	242.00	239.00	mg/l
Alkalinity (CO3)	0.00	0.00	mg/l
Alkalinity (OH)	0.00	0.00	mg/l
Arsenic, As	L 0.001	L 0.001	mg/l
Cadmium, Cd	L 0.001	L 0.001	mg/l
Copper, Cu	L 0.01	L 0.01	mg/l
Lead, Pb	L 0.005	L 0.005	mg/l
Zinc, Zn	0.01	0.01	mg/l
Chromium, Cr	L 0.005	L 0.005	mg/l
Calcium, Ca	69.20	70.80	mg/l
Magnesium, Mg	25.00	25.00	mg/l
Hardness (CaCO3)	276.00	280.00	mg/l
Manganese, Mn	L 0.02	L 0.02	mg/l
Iron, Fe	L 0.02	L 0.02	mg/l
Sodium, Na	3.95	2.92	mg/l
Color	-	-	units
Turbidity	0.35	0.25	NTU
Cyanide, CN	L 0.02	L 0.02	mg/l
NO3-NO2-N	9.40	10.20	mg/l
Chloride, Cl	5.00	5.00	mg/l
Sulphate, SO4	30.00	31.00	mg/l
Coliform Group	-	L 1.00	per 100 ml
Fecal Coliform	-	L 1.00	per 100 ml

L = Less Than

G = Greater Than

Water Quality Analysis

Project: Phase II Landfill Study

Location: Miniota, R.M. of Miniota. NE-25-13-27W

Sample #: 4

Date: Result A; November 4, 1983 Result B; January 12, 1984

Parameter	Result A	Result B	Measured Unit
Conductivity	734.00	718.00	umho/cm
Residue Total	200.00	480.00	mg/l
Residue Filterable	200.00	480.00	mg/l
Residue Non Filterable	L 5.00	L 5.00	mg/l
pH	7.30	7.55	units
Alkalinity Total (CaCO3)	286.00	282.00	mg/l
Alkalinity (HCO3)	349.00	344.00	mg/l
Alkalinity (CO3)	0.00	0.00	mg/l
Alkalinity (OH)	0.00	0.00	mg/l
Arsenic, As	L 0.001	L 0.001	mg/l
Cadmium, Cd	L 0.001	L 0.001	mg/l
Copper, Cu	L 0.01	0.04	mg/l
Lead, Pb	L 0.005	L 0.005	mg/l
Zinc, Zn	0.27	0.65	mg/l
Chromium, Cr	L 0.005	L 0.005	mg/l
Calcium, Ca	95.20	98.60	mg/l
Magnesium, Mg	37.60	37.60	mg/l
Hardness (CaCO3)	393.00	401.00	mg/l
Manganese, Mn	L 0.02	L 0.02	mg/l
Iron, Fe	L 0.02	0.04	mg/l
Sodium, Na	10.40	10.10	mg/l
Color	-	-	units
Turbidity	0.45	0.25	NTU
Cyanide, CN	L 0.02	L 0.02	mg/l
NO3-NO2-N	11.00	12.20	mg/l
Chloride, Cl	22.00	21.00	mg/l
Sulphate, SO4	37.00	40.00	mg/l
Coliform Group	-	L 1.00	per 100 ml
Fecal Coliform	-	L 1.00	per 100 ml

L = Less Than

G = Greater Than

Water Quality Analysis

Project: Phase II Landfill Study

Location: Miniota, R.M. of Miniota. SW-36-13-27W

Sample #: 5

Date: Result A; November 4, 1983 Result B; January 12, 1984

Parameter	Result A	Result B	Measured Unit
Conductivity	474.00	453.00	umho/cm
Residue Total	310.00	300.00	mg/1
Residue Filterable	310.00	300.00	mg/1
Residue Non Filterable	L 5.00	L 5.00	mg/1
pH	7.65	7.70	units
Alkalinity Total (CaCO3)	220.00	206.00	mg/1
Alkalinity (HCO3)	268.00	251.00	mg/1
Alkalinity (CO3)	0.00	0.00	mg/1
Alkalinity (OH)	0.00	0.00	mg/1
Arsenic, As	L 0.001	L 0.001	mg/1
Cadmium, Cd	L 0.001	L 0.001	mg/1
Copper, Cu	0.05	0.04	mg/1
Lead, Pb	L 0.005	L 0.005	mg/1
Zinc, Zn	0.19	0.12	mg/1
Chromium, Cr	L 0.005	L 0.005	mg/1
Calcium, Ca	69.70	70.10	mg/1
Magnesium, Mg	22.60	22.40	mg/1
Hardness (CaCO3)	267.00	267.00	mg/1
Manganese, Mn	L 0.02	L 0.02	mg/1
Iron, Fe	0.02	L 0.02	mg/1
Sodium, Na	2.65	2.52	mg/1
Color	-	-	units
Turbidity	0.30	0.25	NTU
Cyanide, CN	L 0.02	L 0.02	mg/1
NO3-NO2-N	4.40	4.00	mg/1
Chloride, Cl	2.00	3.00	mg/1
Sulphate, SO4	22.00	22.00	mg/1
Coliform Group	-	L 1.00	per 100 ml
Fecal Coliform	-	L 1.00	per 100 ml

L = Less Than

G = Greater Than

3.8

WINNIPEGOSIS WASTE DISPOSAL GROUND

SE-9-31-18W

R.M. OF MOSSEY RIVER #1

3.8 Winnipegosis Waste Disposal Ground

3.8.1 Location

The Village of Winnipegosis, Manitoba is located within the Rural Municipality of Mossey River, approximately 270 kilometres north-west of Winnipeg along P.T.H. 20. The waste disposal area is located about 351 metres west of the village and the legal discription is SE-9-31-18W.

Figure A is a Rural Municipality Map locating the study area and the Village of Winnipegosis within the Rural Municipality of Mossey River.

3.8.2 Physiography

This area is characterized by deep basin sedimentary deposits forming extensive lake plains. These sediments are deposited in a pro-glacial or glacial environment creating a discontinuous veneer reflecting the form of the underlying bedrock topography.

Very little relief is found in the region around the Winnipegosis waste disposal ground. Some bedrock outcrops and some fairly extensive depressional swamp areas can be observed west and southwest of the site. East of the disposal site the topography slopes very gently toward the Mossey River. Regional drainage for this area is from north-west to south-east toward the Mossey River, which eventually reaches Lake Winnipegosis, north-east of the village.

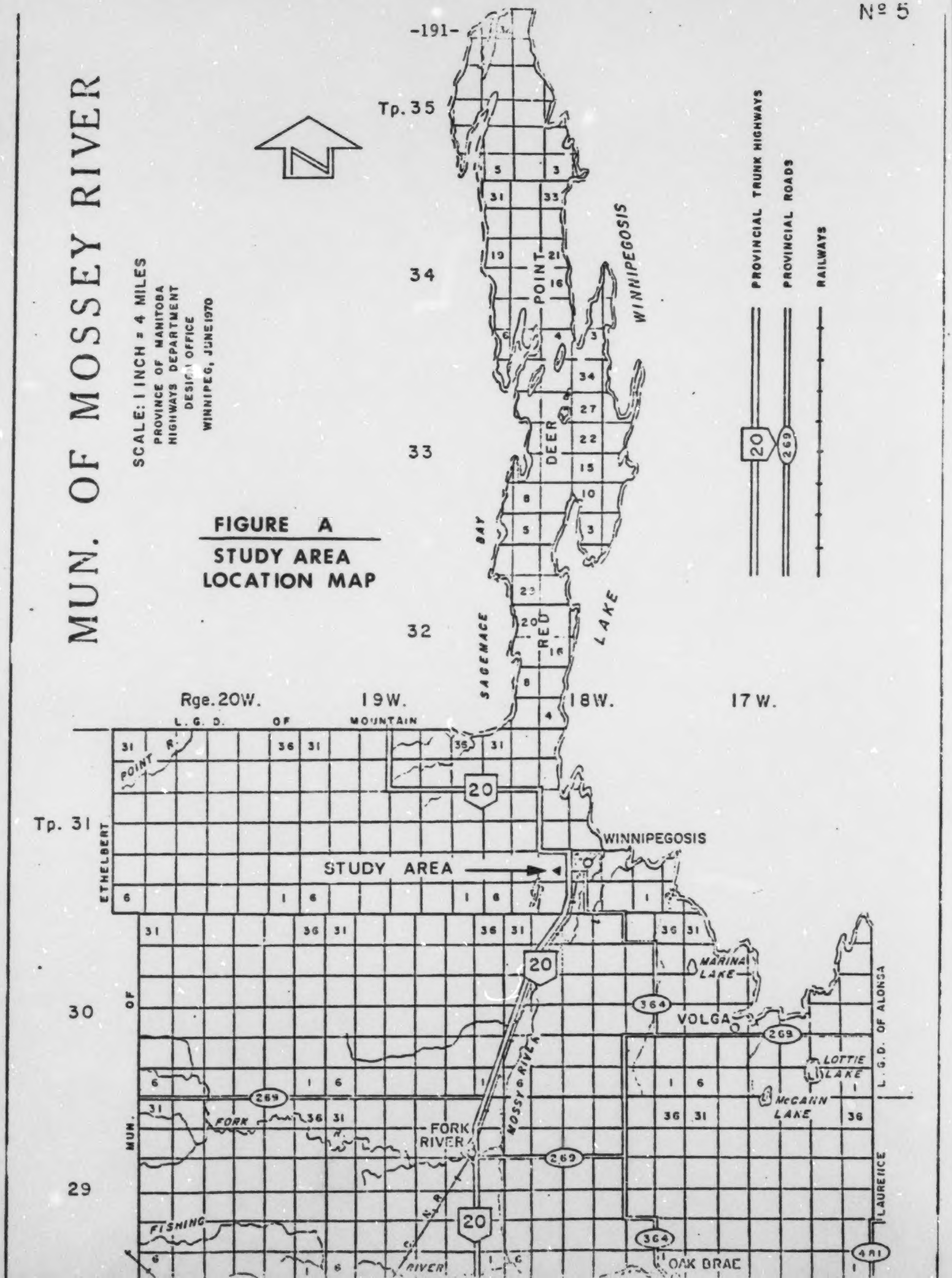


FIGURE A

STUDY AREA LOCATION MAP

MUN. OF MOSSEY RIVER
SCALE: 1 INCH = 4 MILES
PROVINCE OF MANITOBA
HIGHWAYS DEPARTMENT
DESIGN OFFICE
WINNIPEG, JUNE 1970
PROVINCIAL TRUNK HIGHWAYS
PROVINCIAL ROADS
RAILWAYS
20
269
Tp. 35
34
33
32
Tp. 31
30
29
Rge. 20W.
19W.
18W.
17W.
RED DEER POINT
SAGEMACE BAY
WINNIPEGOSIS LAKE
L. G. D. OF MOUNTAIN
POINT R.
ETHELBERT
MUN. OF
WINNIPEGOSIS
STUDY AREA
MARINA LAKE
VOLGA
364
LOTTIE LAKE
McCANN LAKE
L. G. D. OF ALONSA
FORK R.
FORK RIVER
MOSSY RIVER
FISHING RIVER
LAURENCE
OAK BRAE
481

3.8.3 Site Conditions

During the site visit on August 24, 1983, a number of observations were made with regard to the Winnipegosis waste disposal ground. Pictures taken during the site visit serve to illustrate the conditions in and around the active area of disposal. These pictures can be found in Appendix A, along with a detailed description of each view.

The disposal site covers an area of approximately 122 metres in length, (north to south), and 106 metres in width, (east to west). There is no fence around the disposal area, but trees completely surround and conceal the site. Access to the area is by a gravel road directly west of Winnipegosis running west off P.T.H. 20. One small sign on the site indicates "garbage only to be disposed of in this area".

The active area of disposal is a line of refuse piled above ground on the western edge of the site. This working area is approximately 30 metres in length and 3.5 metres wide. A shallow 1 meter deep trench, 65 metres long and 5 metres wide had been excavated west of the working face. It seems that the waste is burned, pushed into the pit, and covered with the excavated fill material. It is expected that this method of operation has progressed from east to west across the site and that the east side of the disposal area has already been filled and compacted.

From information gathered in phase one of this study, it was learned that various types of wastes are dumped at this site. Hospital and school waste along with general household and municipal wastes are routinely disposed of here. During the site inspection, general disposal of sewage or septic sludge was in evidence.

While at the site it was observed that large amounts of water was contained in the excavated pit on the west side of the disposal area. A swamp complete with waterfowl occupies the north-west corner of the disposal area. Surficial drainage of the waste area would enter the swamp easily. Bulky metals seem to be segregated from the active disposal site. An area of disposal for these types of objects is located just outside the north-east corner of the disposal area along the access road. One or two of the small depressions on the site contain what is believed to be sewage or septic sludge.

Pesticide cans, a few small propane gas cylinders and other containers including jerry cans, aerosol spray bombs and paint cans were disposed of in one of many water filled depressional areas on the site. Scaveging birds such as gulls and ravens were plentifull when the site was inspected in August. Some cover material was available on site, and it was piled on the south side of the disposal facility. The east half of the disposal area and the south side of the site were separated from the active area by a 1.2 meter high snow fence. Figure B details the plan view of the site.

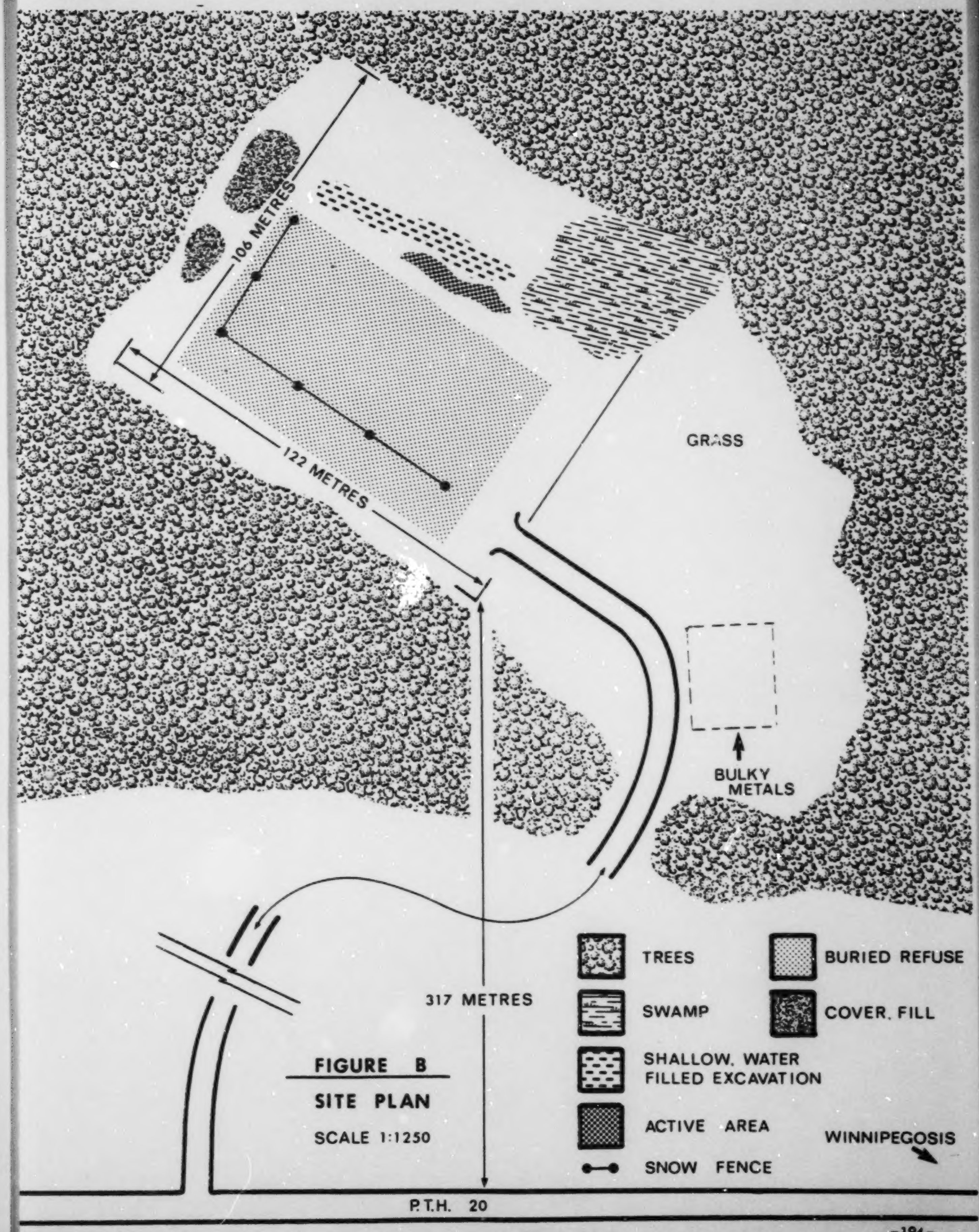

106 METRES
122 METRES
GRASS
BULKY METALS
317 METRES
P.T.H. 20
WINNIPEGOSIS
TREES
BURIED REFUSE
SWAMP
COVER. FILL
SHALLOW. WATER FILLED EXCAVATION
ACTIVE AREA
SNOW FENCE

FIGURE B

SITE PLAN

SCALE 1:1250

3.8.4 Surficial Geology and Hydrogeology

In general the surficial geology of the Winnipegosis area can be directly related to a pro-glacial or glacial environment. Glaciolacustrine clays, silts, sands and some minor gravels were deposited in proglacial lakes. These deep basin deposits may range from 1 to 30 metres in thickness. In the area directly around the disposal site 3 to 8 metres of till containing localized lenses of sand and gravel is common. Some areas of iceberg scouring with thin layers of alluvial deposits masking the underlying glacial debris, along with wave washed till and exposed bedrock outcrops occur in this setting.

The bedrock in this area is made up of carbonate rock, commonly limestone and dolostone. The fractures in the carbonate rock form the most available aquifer, with lenses of sand and gravel forming some small localized aquifers. Most of the domestic water supplies in the Winnipegosis area are drawn from the carbonate rock aquifer.

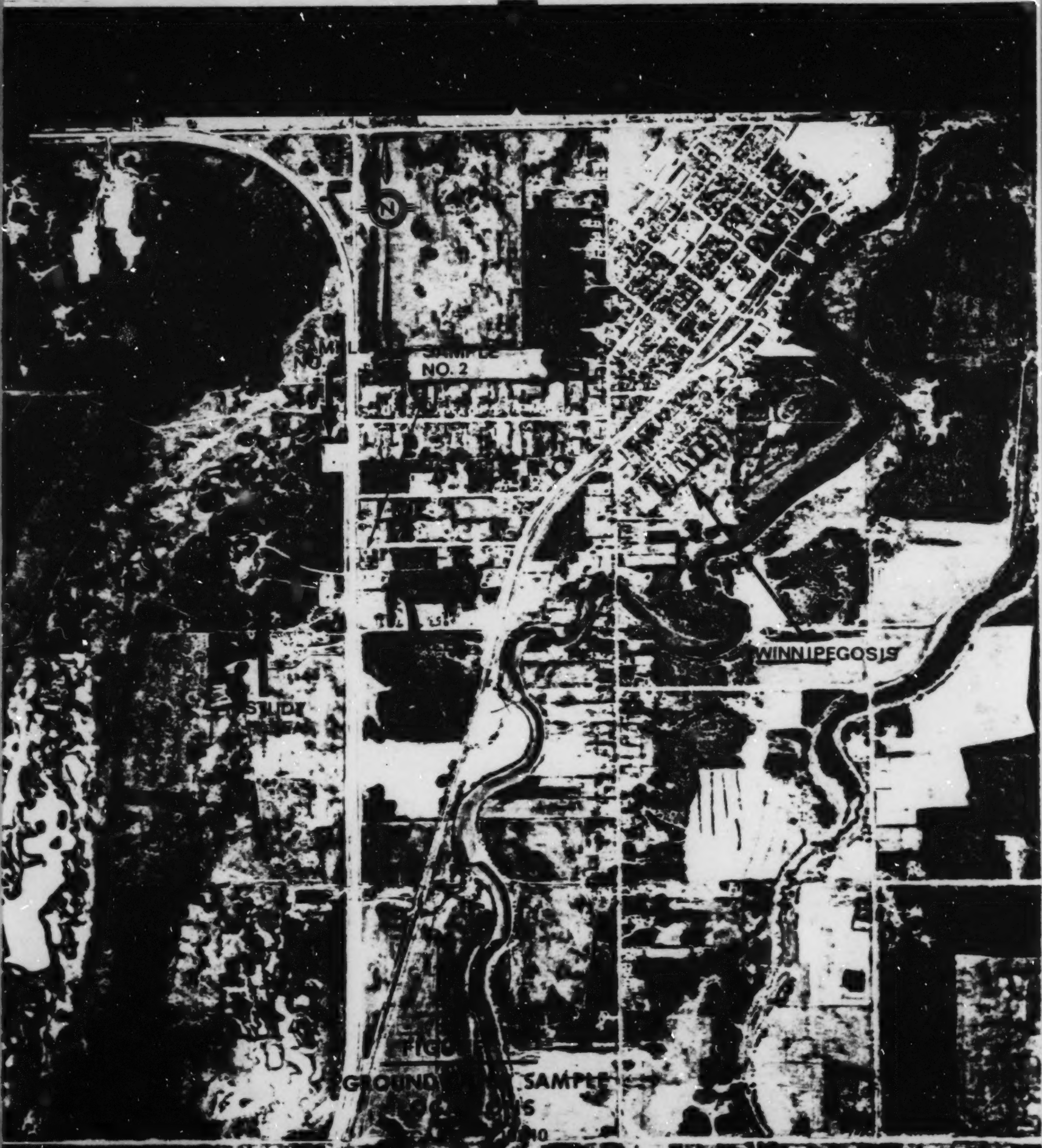
The Water Resources Branch, Department of Natural Resources, Province of Manitoba was requested to complete a groundwater pollution hazard appraisal for the Winnipegosis waste disposal facility. A copy of this appraisal can be found in Appendix B. Basically the comments made on the appraisal agree with the above general geology. This disposal site is located in an area as a groundwater pollution hazard area because the carbonate aquifer is only a few metres below ground level in some locations in and around the disposal site. A field investigation including some test drilling and monitoring well installation to confirm subsurface conditions was indicated.

Through discussion with the steering committee it was decided that because of the difficulty and cost of transporting the required drilling equipment to Winnipegosis and the budget within which this project had to operate, the subsurface part of the field investigation would be postponed until such time as the work became practical.

3.8.5 Groundwater Sampling

On November 22, 1983, and again on January 12, 1984, groundwater samples were collected from 2 residences approximately 355 metres east of the disposal site and the Manitoba Hydro service facility 350 metres to the north-east. These samples were submitted to the W. M. Ward Technical Services Laboratory for analysis. Bacteriological samples were submitted to the Cadham Provincial Laboratory for testing. The results of these analyses can be found in Appendix C.

Figure C is an air photo of the study area at a scale of 1:15840. This photo shows the location of the disposal site with respect to the Town of Winnipegosis. The groundwater sampling points established during the field investigation of this waste disposal site have been located on this air photo.


N
SAMPL
NO
SAMPLE
NO. 2
STUDY
AREA
WINNIPEGOSIS
FIGU
GROUND
SAMPLE
S
10

3.8.6 Analytical Results and Conclusions

With regard to the Winnipegosis waste disposal facility and the phase two assessment of the site, some localized environmental damage of surficial swamps adjacent to the disposal area is taking place. Damage to the underlying carbonate equifer is also suspected but unproven at this time. Data collected to date shows no hazard to the public health which can be directly attributed to the waste disposal ground.

Groundwater

Because the site is considered to be in a groundwater pollution hazard area a test drilling and monitoring well installation program could be undertaken to confirm subsurface geologic and hydrogeologic conditions. The regional groundwater flow is towards the Mossey River and therefore underneath the Village of Winnipegosis. Contamination of the carbonate aquifer by leachates from the waste disposal ground becomes a concern with respect to the domestic water supplies drawing water from this groundwater aquifer. Test drilling to confirm drift thickness between the waste and the carbonate rock aquifer and monitoring well installation to observe groundwater quality is required before further conclusions can be made with respect to the geologic and hydrogeologic characteristics of the area.

Water quality analyses conducted on the two domestic water supplies and the Manitoba Hydro service facility water supply were compared to the "Guidelines for Canadian Drinking Water Quality" prepared by Health and Welfare Canada in 1978. Samples #1, (Hydro) and sample #2, (domestic) can be described in general as good quality for public consumption. The only parameter of health significance was the nitrate count of sample #2 which was above the maximum acceptable limit when sampled on November 22, 1983. Results from sample #3, the second domestic water supply east of the disposal facility, indicate not only a higher than acceptable nitrate content, but significant differences in a number of parameters when compared to the other groundwater samples collected from this area. At the present time these results can not be attributed directly to the waste disposal facility. This problem may be the result of some localized source of pollution, however, further investigative work consists of test drilling, monitoring wells installation and sampling is warranted to determine the source of contamination.

Methane

Methane gas produced through the decomposition of burried domestic waste can be of concern to buildings located in close proximity to waste disposal sites. In this case, however, because of the surface soil conditions and the distance to the nearest building, 250 metres south of the site, methane gas production if any, would not be of concern.

Surface Water

Surface water contamination from the waste disposal ground is an ongoing problem. Surface runoff through the waste area flows directly into a swamp located in the north-west corner of the disposal facility. Standing pools of water on the west side of the disposal area have varying amounts of waste within their boundaries. After examination of the air photos, the facility itself and the other data collected, it seems that this facility has been located on the eastern edge of a fairly extensive swampland area. Direct hydraulic connection to the groundwater table is likely.

3.8.7 Recommendations

1) All pesticide containers should be drained and stored in a separate area away from the active disposal site. Crushing the containers reduces the size of the storage area required to hold the empty cans. Draining the cans reduces the risk of environmental pollution from pesticide residues. All drainings should be collected and disposed of in an approved manner.
2) The disposal of septic sludge and sewage waste in the active disposal area should be discontinued. This type of disposal can be of an environmental and health concern. Sewage and septic sludge should be disposed of in a separate facility constructed for that purpose, within the disposal area, or at a suitably designed sewage treatment facility.
3) All bulky metals should be stored in a separate, above grade compound away from the active area of disposal.
4) Further sampling of residences and monitoring wells to be installed during a test drilling program is warranted before further conclusions can be drawn.

5) If data collected from the above recommended testing shows further environmental damage and concern for the public health, consideration should be given to locating a new disposal site in an area where ground and surface water contamination will not occur.

6) Refer to Manitoba Regulation 208/76 under the Clean Environment Act for further clarification of these recommendations and other waste disposal ground operating procedures.

APPENDIX A

Date: August 24, 1983 Location: Winnipegosis Waste Disposal Ground

Orientation: Taken from the entrance to the disposal area looking north-west.

Comments: This seems to be the bulk metals disposal area.

Date: August 24, 1983 Location: Winnipegosis Waste Disposal Ground

Orientation: Taken from the west side of the active area looking north.

Comments: This view shows the active working area of disposal. In the upper center of the photograph behind the smoke a small swamp intrudes on the waste disposal ground.

Date: August 24, 1983 Location: Winnipegosis Waste Disposal Ground

Orientation: Taken from the south-west corner of the site looking north.

Comments: This is the trench excavated for waste disposal. As can be seen it is full of water. Burning of the waste is ongoing at this site.

Date: August 24, 1983 Location: Winnipegosis Waste Disposal Ground

Orientation: A pool of liquid located centrally within the active area.

Comments: Note the various containers floating in the liquid. It is believed that some of the liquid contained in this pool is the result of sewage disposal.

APPENDIX B

WATER RESOURCES BRANCH

FILE NO. 5.7.4.2.

GROUNDWATER POLLUTION HAZARD APPRAISAL

POTENTIAL SOURCE OF POLLUTION	Waste Disposal Ground
LOCATION OF SOURCE	SE9-31-18W
OWNER OF SOURCE	R.M. of Massey River, Winnipegosis

GEOLOGICAL CONDITIONS	SURFICIAL DEPOSITS	From 3 m to 8 m of glacial till with lenses of sand and gravel within and at the base of the till.
	BEDROCK	Carbonate rock (limestone, dolostone)

GROUNDWATER CONDITIONS	AQUIFERS	The carbonate rock constitutes the main aquifer in the area. The lenses of sand and gravel form minor aquifers. The general groundwater movement likely is southeasterly toward Massey River.
	WELLS	Nearly all the wells reported in the vicinity draw water from the carbonate rock aquifer. Some wells have been completed in the sand and gravel aquifers.

POLLUTION HAZARD

Because in some places the carbonate rock is only a few metres below ground level ground water pollution hazard exists on this quarter section.

COMMENTS

The leachates from the waste disposal ground are not likely to affect ground water quality in the vicinity of the municipal well of the Village of Winnipegosis.

BY: M. Rutulis, P. Eng.
GROUNDWATER GEOLOGIST

DATE: Dec. 7, 1983

APPENDIX C

Water Quality Analysis

Project: Phase II Landfill Study

Location: Winnipegosis, R.M. of Mossey River. SE-9-31-18W

Sample #: 1

Date: Result A; November 22, 1983 Result B; N/A

Parameter	Result A	Result B	Measured Unit
Conductivity	1630.00	-	umho/cm
Residue Total	970.00	-	mg/l
Residue Filterable	950.00	-	mg/l
Residue Non Filterable	20.00	-	mg/l
pH	7.50	-	units
Alkalinity Total (CaCO3)	522.00	-	mg/l
Alkalinity (HCO3)	637.00	-	mg/l
Alkalinity (CO3)	0.00	-	mg/l
Alkalinity (OH)	0.00	-	mg/l
Arsenic, As	L 0.001	-	mg/l
Cadmium, Cd	L 0.001	-	mg/l
Copper, Cu	L 0.01	-	mg/l
Lead, Pb	L 0.005	-	mg/l
Zinc, Zn	0.03	-	mg/l
Chromium, Cr	L 0.005	-	mg/l
Calcium, Ca	68.00	-	mg/l
Magnesium, Mg	121.00	-	mg/l
Hardness (CaCO3)	668.00	-	mg/l
Manganese, Mn	L 0.02	-	mg/l
Iron, Fe	0.39	-	mg/l
Sodium, Na	130.00	-	mg/l
Color	-	-	units
Turbidity	10.00	-	NTU
Cyanide, CN	L 0.02	-	mg/l
NO3-NO2-N	1.56	-	mg/l
Chloride, Cl	220.00	-	mg/l
Sulphate, SO4	77.00	-	mg/l
Coliform Group	L 1.00	-	per 100 ml
Fecal Coliform	L 1.00	-	per 100 ml

L = Less Than

G = Greater Than

Water Quality Analysis

Project: Phase II Landfill Study

Location: Winnipegosis, R.M. of Mossey River. SW-10-31-18W

Sample #: 2

Date: Result A; November 22, 1983 Result B; January 12.1984

Parameter	Result A	Result B	Measured Unit
Conductivity	1250.00	1250.00	umho/cm
Residue Total	770.00	770.00	mg/l
Residue Filterable	770.00	770.00	mg/l
Residue Non Filterable	L 5.00	L 5.00	mg/l
pH	7.15	7.15	units
Alkalinity Total (CaCO3)	518.00	512.00	mg/l
Alkalinity (HCO3)	632.00	625.00	mg/l
Alkalinity (CO3)	0.00	0.00	mg/l
Alkalinity (OH)	0.00	0.00	mg/l
Arsenic, As	L 0.001	L 0.001	mg/l
Cadmium, Cd	L 0.001	L 0.001	mg/l
Copper, Cu	0.06	0.01	mg/l
Lead, Pb	L 0.005	L 0.005	mg/l
Zinc, Zn	0.02	0.01	mg/l
Chromium, Cr	L 0.005	L 0.005	mg/l
Calcium, Ca	96.50	109.00	mg/l
Magnesium, Mg	100.00	106.00	mg/l
Hardness (CaCO3)	653.00	709.00	mg/l
Manganese, Mn	L 0.02	L 0.02	mg/l
Iron, Fe	L 0.02	L0.02	mg/l
Sodium, Na	28.00	25.30	mg/l
Color	-	-	units
Turbidity	45.00	30.00	NTU
Cyanide, CN	L 0.02	L 0.02	mg/l
NO3-NO2-N	10.20	9.40	mg/l
Chloride, Cl	81.00	83.00	mg/l
Sulphate, SO4	40.00	45.00	mg/l
Coliform Group	L 1.00	L 1.00	per 100 ml
Fecal Coliform	L 1.00	L 1.00	per 100 ml

L = Less Than
G = Greater Than

Water Quality Analysis

Project: Phase II Landfill Study

Location: Winnipegosis, R.M. of Mossey River. SW-10-31-18W

Sample #: 3

Date: Result A; November 22, 1983 Result B; N/A

Parameter	Result A	Result B	Measured Unit
Conductivity	2570.00	-	umho/cm
Residue Total	1600.00	-	mg/l
Residue Filterable	1600.00	-	mg/l
Residue Non Filterable	L 5.00	-	mg/l
pH	7.15	-	units
Alkalinity Total (CaCO3)	470.00	-	mg/l
Alkalinity (HCO3)	573.00	-	mg/l
Alkalinity (CO3)	0.00	-	mg/l
Alkalinity (OH)	0.00	-	mg/l
Arsenic, As	L 0.001	-	mg/l
Cadmium, Cd	L 0.001	-	mg/l
Copper, Cu	0.04	-	mg/l
Lead, Pb	L 0.005	-	mg/l
Zinc, Zn	0.02	-	mg/l
Chromium, Cr	L 0.005	-	mg/l
Calcium, Ca	142.00	-	mg/l
Magnesium, Mg	115.00	-	mg/l
Hardness (CaCO3)	828.00	-	mg/l
Manganese, Mn	L 0.02	-	mg/l
Iron, Fe	L 0.02	-	mg/l
Sodium, Na	261.00	-	mg/l
Color	-	-	units
Turbidity	0.60	-	NTU
Cyanide, CN	L 0.02	-	mg/l
NO3-NO2-N	11.40	-	mg/l
Chloride, Cl	560.00	-	mg/l
Sulphate, SO4	64.00	-	mg/l
Coliform Group	L 1.00	-	per 100 ml
Fecal Coliform	L 1.00	-	per 100 ml

L = Less Than

G = Greater Than

3.9

STONEWALL WASTE DISPOSAL GROUND

NW-30-13-2E

R.M. OF ROCKWOOD #8

3.9 Stonewall Waste Disposal Ground

3.9.1 Location

The Town of Stonewall, Manitoba is located within the Rural Municipality of Rockwood, approximately 16 kilometres north of Winnipeg along P.T.H. 67. The inactive waste disposal area is located within the Town of Stonewall at a site now occupied by Flexon Industries and Interlake Dairy Supplies. The legal description of the site is NW-30-13-2E.

Figure A is a Rural Municipality Map locating the study area and the Town of Stonewall within the Rural Municipality of Rockwood.

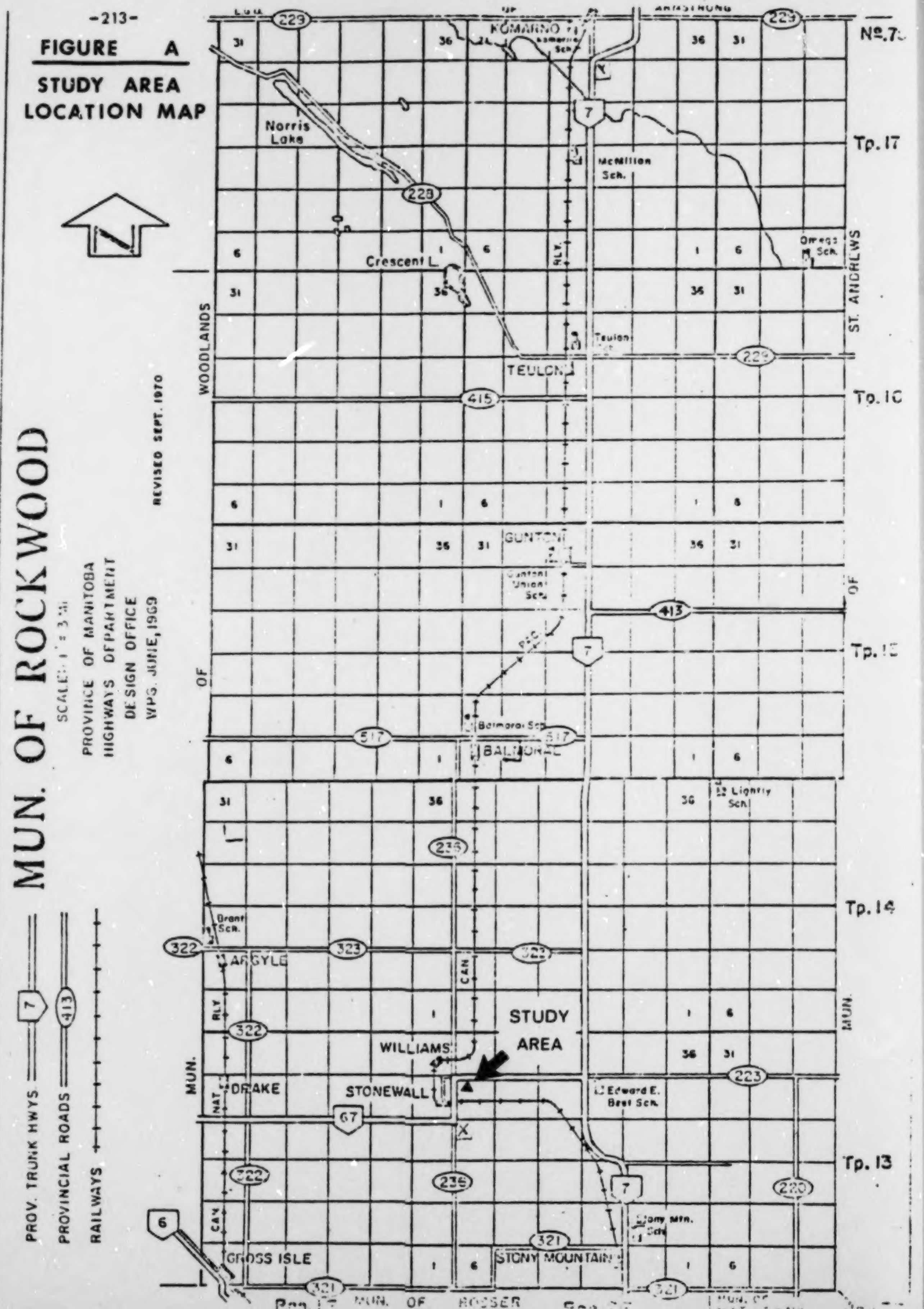
3.9.2 Physiography

This region is characterized by deep basin glaciolacustrine sedimentation 1 to 30 metres thick forming extensive lake plains and creating a discontinuous veneer reflecting the form of the underlying bedrock topography. The surface topography directly below Stonewall is slightly raised when compared to the surrounding flat prairie. This is due to a slight humping in the underlying carbonate bedrock. The bedrock within the Town of Stonewall has been extensively quarried. This quarrying forms the only significant relief in and around the Town of Stonewall.

Surface water in the vicinity of the disposal site is represented by small lakes and collection ponds in the rock quarries. It is likely that a direct hydraulic connection exsists between the

FIGURE A

STUDY AREA LOCATION MAP


MUN. OF ROCKWOOD
SCALE 1" = 3 mi
PROVINCE OF MANITOBA
HIGHWAYS DEPARTMENT
DESIGN OFFICE
WPG. JUNE, 1969
REVISED SEPT. 1970
PROV. TRUNK HWYS
PROVINCIAL ROADS
RAILWAYS
7
413
WOODLANDS
OF
MUN.
ARMSTRONG
ST. ANDREWS
OF
MUN.
No. 7
Tp. 17
Tp. 16
Tp. 15
Tp. 14
Tp. 13
229
228
415
413
517
236
322
323
223
220
321
67
6
Norris Lake
Crescent L.
KOMARNO
Komarno Sch.
McMillan Sch.
Omega Sch.
RLY.
Teulon Sch.
TEULON
GUNTON
Gunton Union Sch.
Balmoral Sch.
BALMORAL
Lightly Sch.
Grant Sch.
ARGYLE
CAN.
NAT.
DRAKE
WILLIAMS
STONEWALL
STUDY AREA
Edward E. Best Sch.
Stony Mtn. Sch.
STONY MOUNTAIN
GROSS ISLE
MUN. OF ROSSER
31
36
6
1

surface water in the quarries and the groundwater aquifer within the carbonate bedrock. Some of these small lakes are used for recreational purposes.

Regional drainage for the Stonewall area is from west to east. Surficial drainage directly around the study area would be to the field east of the site or to the quarry south-west of the disposal area. Figure B is a Town of Stonewall Map locating the study area within the Town of Stonewall.

3.9.3 Site Conditions

During the site visit on August 11, 1983, a number of observations were made with regard to the Stonewall waste disposal facility. Pictures taken during the site visit serve to illustrate the conditions in and around the inactive area of disposal. These pictures can be found in Appendix A along with a detailed description of each view.

The inactive disposal site lies 46 metres south of P.T.H. 67 and covers an area of approximately 68 metres in length, (north to south) by 70 metres in width, (east to west). Access to the area is directly south off P.T.H. 67 approximately 301 metres east of the fourth street east P.T.H. 67 junction in Stonewall.

From information gathered during phase I of this study and interviews conducted during the initial site visit, it was learned that this disposal site was closed prior to the 1950's. It was used as a disposal facility for general municipal and domestic wastes

No. 75 A.

TOWN OF STONEWALL

PART OF SEC'S. 25 & 36-13-1E., PART OF SEC'S. 30 & 31-13-2E.

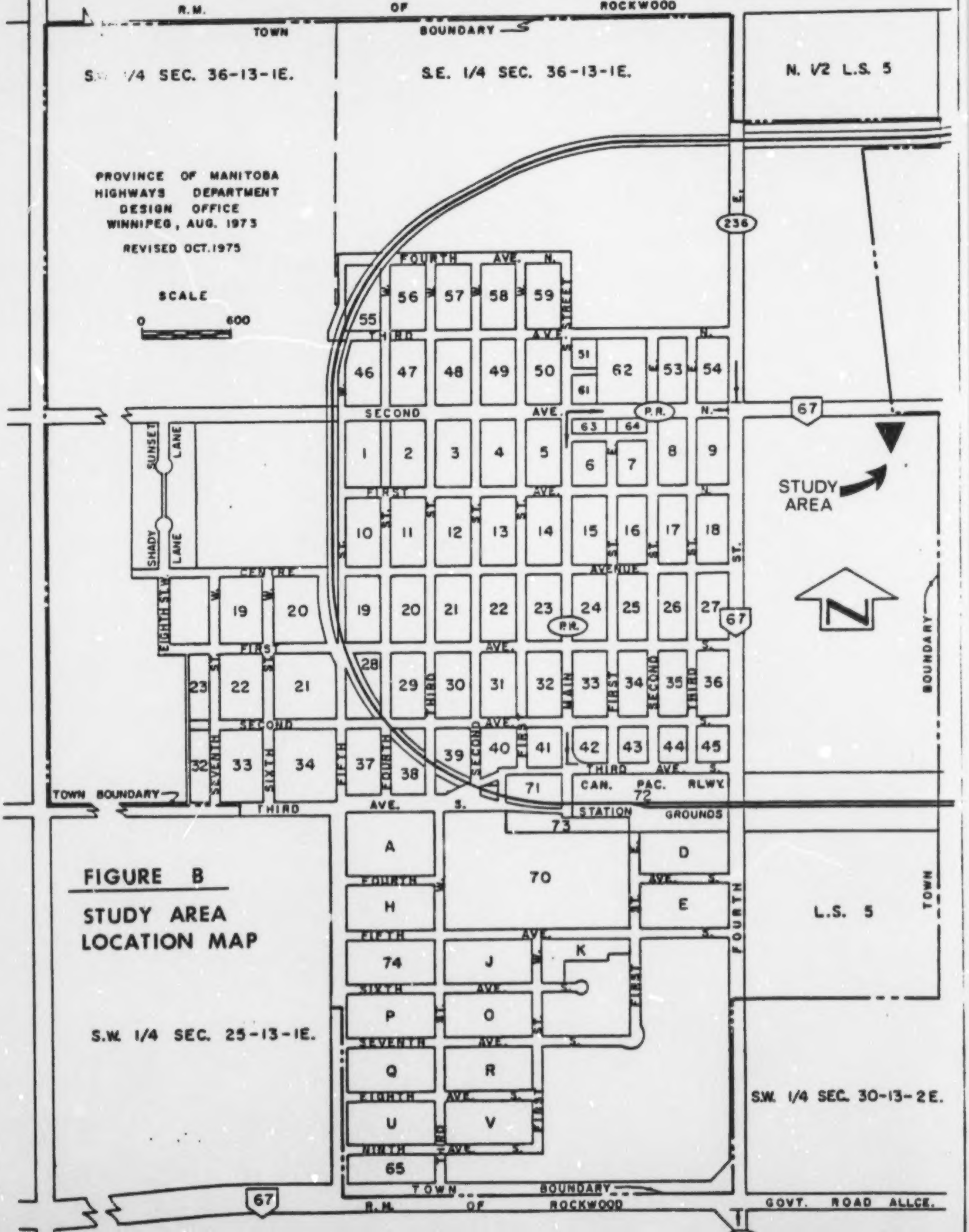

R.M. OF ROCKWOOD
TOWN BOUNDARY
S.W. 1/4 SEC. 36-13-1E.
S.E. 1/4 SEC. 36-13-1E.
N. 1/2 L.S. 5
PROVINCE OF MANITOBA
HIGHWAYS DEPARTMENT
DESIGN OFFICE
WINNIPEG, AUG. 1973
REVISED OCT. 1975
SCALE
0
600
236
67
P.R.
STUDY AREA
N
BOUNDARY
FOURTH AVE. N.
THIRD AVE. N.
SECOND AVE. N.
FIRST AVE. N.
CENTRE AVENUE
FIRST AVE. S.
SECOND AVE. S.
THIRD AVE. S.
FOURTH AVE. S.
FIFTH AVE. S.
SIXTH AVE. S.
SEVENTH AVE. S.
EIGHTH AVE. S.
NINTH AVE. S.
SUNSET LANE
SHADY LANE
EIGHTH ST. W.
SEVENTH
SIXTH
FIFTH
FOURTH
THIRD
SECOND
FIRST
MAIN
FIRST ST. E.
SECOND
THIRD
FOURTH ST. E.
CAN. PAC. RLWY.
STATION GROUNDS
TOWN BOUNDARY
1 2 3 4 5 6 7 8 9
10 11 12 13 14 15 16 17 18
19 20 21 22 23 24 25 26 27
28 29 30 31 32 33 34 35 36
37 38 39 40 41 42 43 44 45
46 47 48 49 50 51 53 54 55 56 57 58 59
61 62 63 64 65 70 71 72 73 74
A D E H J K O P Q R U V
L.S. 5
S.W. 1/4 SEC. 25-13-1E.
S.W. 1/4 SEC. 30-13-2E.
TOWN
GOVT. ROAD ALLCE.

FIGURE B

STUDY AREA LOCATION MAP

including bulk metals such as car bodies, appliances and scrap metal. The waste disposed of at this particular site has been covered with a reported 1 to 3 metres of earthern fill material. A number of buildings now occupy the inactive disposal area. These include Interlake Dairy Supplies, Flexon Industries and a few older barn type buildings on the south side of the property, probably used for storage. Apparently waste was contacted during the foundation construction for the extension to the Flexon Industries Plant. Since the initial site visit the foundation for the Interlake Refrigeration and Air Conditioning building has been poured. This building will be located on the north-west corner of the study area.

Vegetation around the study area consists of grass and small shrubs bordering the north, east and west sides of the site. A small stand of trees lines the southern perimeter of the disposal area. Figure C details the plan view of the site.

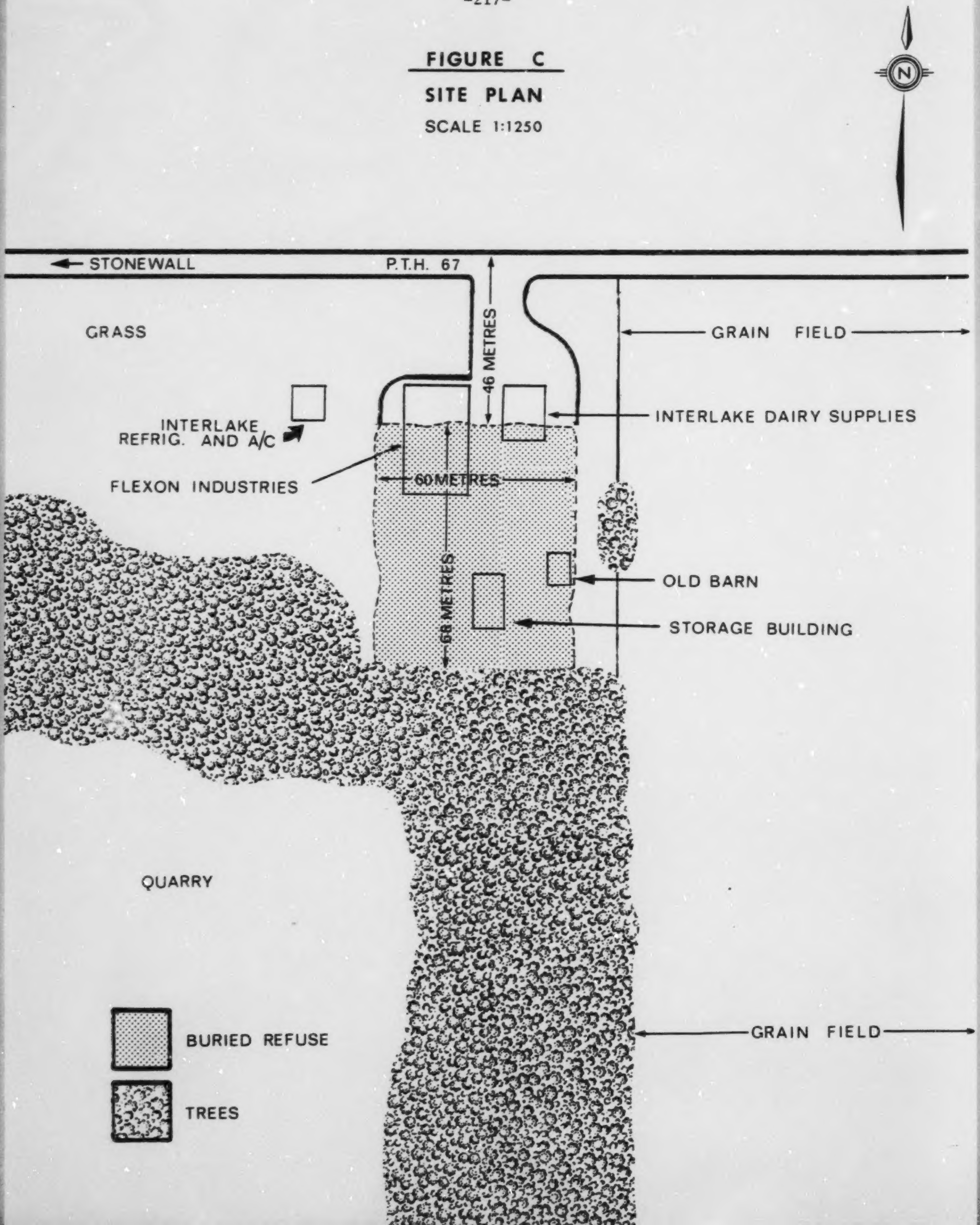
3.9.4 Surficial Geology and Hydrogeology

In general the surficial geology of the Stonewall area can be directly related to a pro-glacial or glacial environment. In the area surrounding Stonewall glaciolacustrine clay, silt, sand and some minor gravel were deposited in pro-glacial lakes. These deep basin deposits range from 1 to 30 metres in thickness. Areas of iceberg scouring are common and in places, thin layers of alluvial deposits mask the underlying glacial debris. Wave washed till and exposed bedrock are also common in this setting.

FIGURE C

SITE PLAN

SCALE 1:1250


N
STONEWALL
P.T.H. 67
46 METRES
GRASS
GRAIN FIELD
INTERLAKE REFRIG. AND A/C
INTERLAKE DAIRY SUPPLIES
FLEXON INDUSTRIES
60 METRES
68 METRES
OLD BARN
STORAGE BUILDING
QUARRY
BURIED REFUSE
TREES
GRAIN FIELD

In the vicinity of the disposal site only a thin gritty layer of till covers the carbonate bedrock. 0 to 5 metres of this till is common but frequent occurrences of exposed limestone and dolostone can be observed throughout Stonewall. Directly south-west of the disposal area quarrying operations have removed some of the bedrock surface. Very little surface till can be seen overlying the carbonate bedrock.

The carbonate bedrock is highly fractured and is the common source of groundwater in the area. All of the domestic groundwater supplies known to be in the vicinity of the inactive disposal area draw water from the carbonate aquifer. The major water bearing zone is 20 to 30 metres below ground level.

The Water Resources Branch, Department of Natural Resources, Province of Manitoba, was requested to complete a groundwater pollution hazard appraisal for the inactive Stonewall waste disposal facility. A copy of this appraisal can be found in Appendix B. Basically, the comments made on this appraisal agree with the above general geology. This disposal site is located in an area designated as a groundwater pollution hazard area because the waste buried at this site is probably in contact with the bedrock surface. Fractures in the bedrock surface extend down to the water bearing zone allowing waste disposal ground leachate to migrate into the groundwater.

A field investigation including test drilling and monitoring well installation was initially formulated for this site. After the initial site visit and through discussion with the project steering committee, it was decided that a sufficient number of collection points were available in and around the study area for groundwater monitoring. It was also felt that subsurface confirmatory test drilling was not necessary.

3.9.5 Groundwater Sampling

On November 18, 1983 and again on January 17, 1984, groundwater samples were collected from 6 selected monitoring locations. These samples were submitted to the W. M. Ward Technical Services Laboratory for analysis. Bacteriological samples were submitted to the Cadham Provincial Laboratory for testing. The results of these analyses can be found in Appendix C.

Figure D is an air photo of the study area at a scale of 1:15840. This photo shows the location of the disposal site with respect to the Town of Stonewall. The groundwater sampling points established during the field investigation of this waste disposal site have been located on this air photo.

3.9.6 Analytical Results and Conclusions

With regard to the Stonewall inactive waste disposal facility and the phase 2 assessment of the site, there is no observed effect on the surrounding environment. Data collected throughout the study shows no hazard to the public health which can be directly attributed to the waste disposal ground.

Groundwater

This disposal facility is considered to be in a groundwater pollution hazard area and a field investigation was formulated for the study site. Because of the near surface proximity of the carbonate

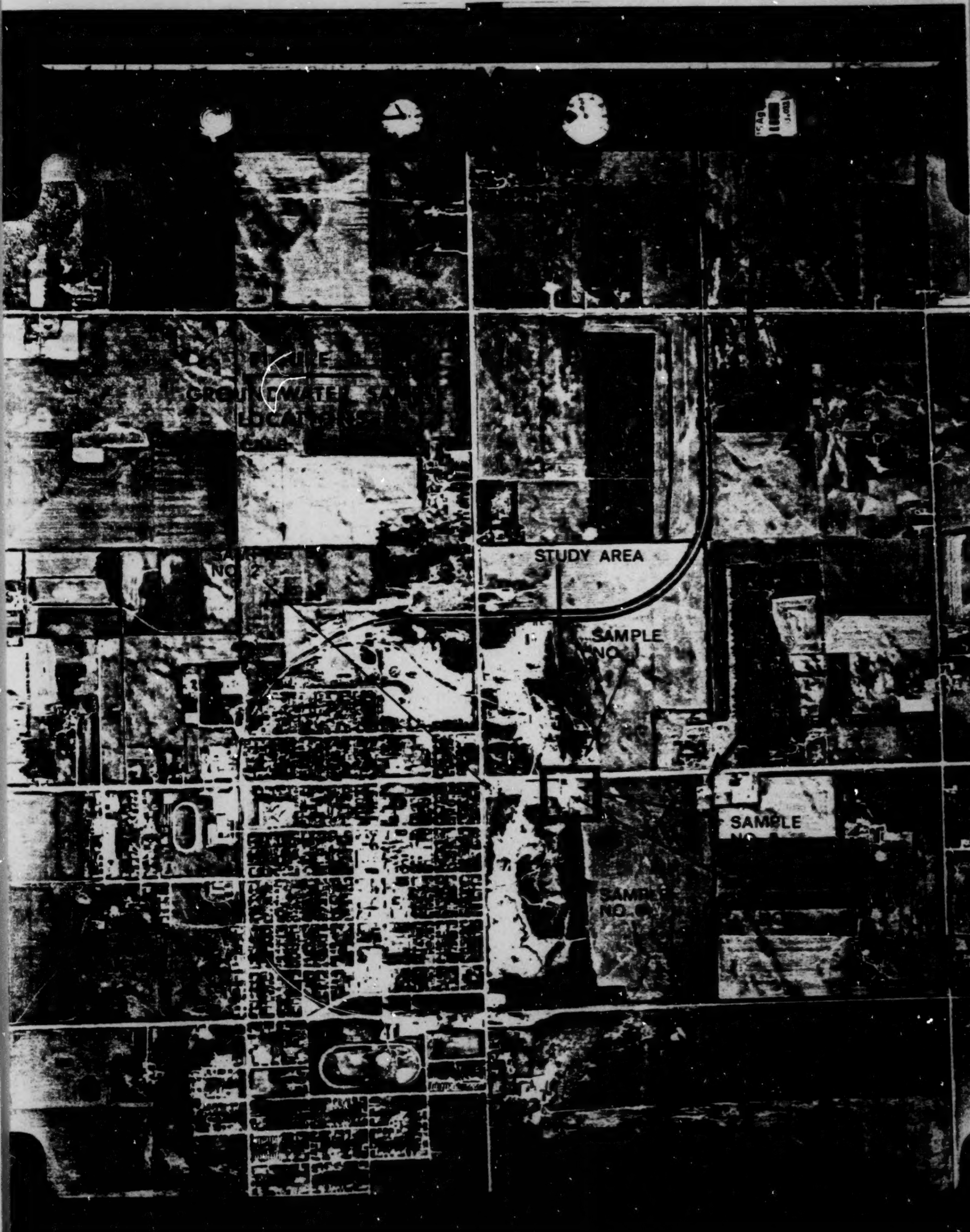


FIGURE
GROUNDWATER SAMPLE
LOCATIONS
STUDY AREA
SAMPLE NO. 2
SAMPLE NO. 1
SAMPLE NO.
SAMPLE NO.

bedrock and the number of groundwater supply wells in the immediate vicinity of the study area, test drilling and monitoring well installation was not included in this investigation.

Only a thin veneer of gritty till material overlies the fractured carbonate bedrock at this site. It is expected that waste is in direct contact with the fractured bedrock surface and, therefore, leachates will have some hydraulic connection with the groundwater table.

Water quality analyses conducted on the 6 groundwater samples collected from the sample points selected for this study were compared to the "Guidelines for Canadian Drinking Water Quality" prepared by Health and Welfare Canada in 1978. The Flexon Industries well (sample #4) supplies groundwater to both the Flexon building and the neighbouring Interlake Dairy Supply building (sample #5). From reports gathered during the initial site visit it was learned that this well was drilled directly through the waste disposal site. Samples #2 through #6 can be described in general as good quality for domestic purposes. The only parameter of health significance was the nitrate content in samples #2 through #5. These samples all showed nitrates just slightly higher than the maximum acceptable limit. These results seem fairly constant over the entire area and can not be directly attributed to the inactive disposal facility.

Results from sample #1, a domestic groundwater supply well located 50 metres north-east of the study area, indicate not only an unusually high nitrate count but significant differences in a number of parameters when compared to the other groundwater samples collected from this area. At the present time these results can not be directly attributed to the inactive waste disposal facility. This problem may be the result of some localized source of contamination. Further sampling of the groundwater supplies in the area is required before other conclusions can be drawn with respect to this particular problem.

Methane

Methane gas produced through the decomposition of buried domestic waste can be of concern to buildings located in close proximity to waste disposal sites. In this case, methane gas production may be of concern to the Flexon and Interlake Dairy Supply buildings as well as the new Interlake Air Conditioning and Refrigeration building being constructed on the north-west corner of the study area.

Explosimeter tests were not conducted in these buildings during the initial site visits. Because of the nature of the manufacturing process and the fumes associated with this process, explosimetre readings were not obtainable from the Flexon Industries building. A methane gas survey, including the installation of gas probes on the inactive disposal ground is required before conclusions can be drawn over concerns about methane gas buildup in the buildings constructed upon the inactive Stonewall disposal facility.

Surface Water

Surface water pollution of any natural water body is not likely to occur at this particular site. No natural surface water course exsists in close proximity to the inactive waste disposal ground.

Contamination of water collected in quarries south-west and north-west of the study area may occur if leachate produced in the inactive waste disposal ground migrates down to the groundwater table and the carbonate bedrock aquifer is hydraulically connected to the quarry pools. Further groundwater flow testing would be required in order to prove this possibility.

Surficial runoff is not likely to have any effect on the surface water collected in the quarries because of the distance to these pools and the surficial soils and bedrock characteristics in the area.

3.9.7 Recommendations

1) Further sampling of the established monitoring points is required before further conclusions can be drawn with respect to the contamination problem at sample #1 and the relationship of this problem with the inactive Stonewall waste disposal ground.
2) A methane gas survey including the installation of gas probes at the inactive disposal site and explosimeter testing in the buildings occupying the area is required before conclusions can be drawn with regard to concerns over methane gas buildup in these buildings.
3) Refer to Manitoba Regulation 208/76 under the Clean Environment Act for further clarification of these recommendations and other waste disposal ground operating procedures.

APPENDIX A

Date: August 11, 1983 Location: Stonewall Waste Disposal Ground

Orientation: Taken from P.T.H. 67 Looking south.

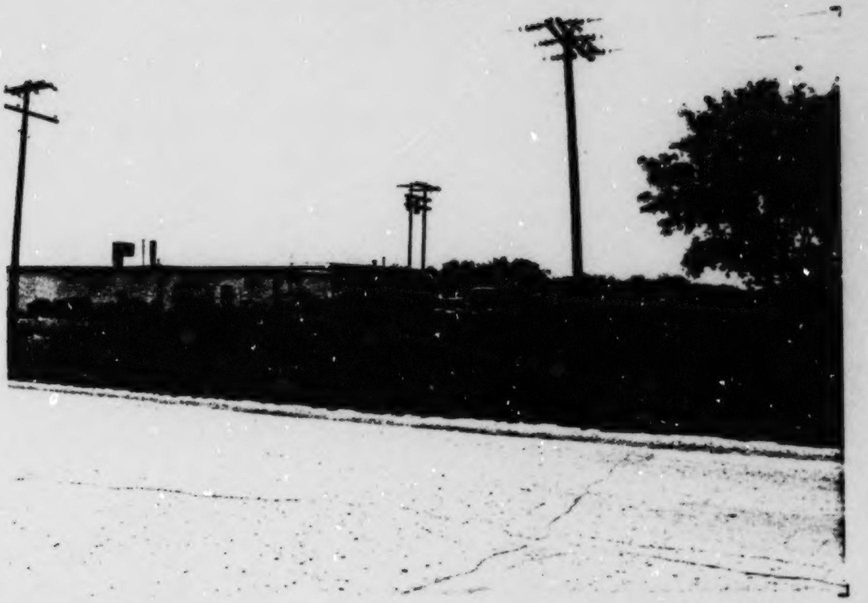
Comments: This picture shows the eastern boundary of the inactive disposal area indicated by the telephone poles on the left side of the photograph. Interlake Dairy Supplies is located upon the site.

HOULE
LEXON

Date: August 11, 1983 Location: Stonewall Waste Disposal Ground

Orientation: Taken from P.T.H. 67 looking south.

Comments: Interlake Dairy Supplies and Flexon Industries buildings are both located upon the inactive disposal area. The trees seen between the two buildings indicate the southern boundary of the waste area.



Date: August 11, 1983 Location: Stonewall Waste Disposal Ground

Orientation: Taken from P.T.H. 67 looking south-east.

Comments: This picture indicates the western extent of the inactive disposal area. The boundary line runs from the single pole to the left of the photo through the double pole, on to the trees.

Date: August 11, 1983 Location: Stonewall Waste Disposal Ground

Orientation: Taken from south-west of the site looking north-east.

Comments: This view was taken from the quarry south-west of the inactive disposal area. The building at the left center of the photograph is the Flexon Industries Building.

Date: October 11, 1983 Location: Stonewall Waste Disposal Ground

Orientation: Taken from P.T.H. 67 looking south.

Comments: Shows the new location of the Interlake Refrigeration and Air Conditioning Building. This development is just of the north-west corner of the inactive disposal area. Flexon is on the left .

APPENDIX B

FILE No. 5.7.4.2.

WATER RESOURCES BRANCH

GROUNDWATER POLLUTION HAZARD APPRAISAL

POTENTIAL SOURCE OF POLLUTION	Waste Disposal Ground
LOCATION OF SOURCE	NW30-13-2E
OWNER OF SOURCE	R.M. of Rockwood, Stonewall

GEOLOGICAL CONDITIONS	SURFICIAL DEPOSITS	From zero to 5 m of till.
	BEDROCK	Carbonate rock (limestone and dolostone).

GROUNDWATER CONDITIONS	AQUIFERS	The carbonate rock constitutes the only aquifer in the area. The main water bearing zone is 20 m to 30 m below ground level.
	WELLS	All wells reported in the area draw water from the carbonate rock aquifer.

POLLUTION HAZARD

Because the carbonate rock is exposed or covered only by thin gritty till layer and fractures in the bedrock likely extend to the water bearing zone, groundwater pollution by leachates from the waste disposal ground is likely.

COMMENTS

This is a very undesirable area for a waste disposal ground. Leachates from the disposal ground, however, are not likely to affect the municipal water supply.

BY: M. Rutulis, P. Eng.
GROUNDWATER GEOLOGIST

DATE: Dec. 7, 1983

APPENDIX C

Water Quality Analysis

Project: Phase II Landfill Study.

Location: Stonewall, R.M. of Rockwood. SW-31-13-2E

Sample #: 1

Date: Result A; November 18, 1983 Result B; January 17, 1984

Parameter	Result A	Result B	Measured Unit
Conductivity	1770.00	1375.00	umho/cm
Residue Total	1260.00	1150.00	mg/1
Residue Filterable	1260.00	1150.00	mg/1
Residue Non Filterable	L 5.00	L 5.00	mg/1
pH	7.20	7.35	units
Alkalinity Total (CaCO3)	626.00	550.00	mg/1
Alkalinity (HCO3)	764.00	671.00	mg/1
Alkalinity (CO3)	0.00	0.00	mg/1
Alkalinity (OH)	0.00	0.00	mg/1
Arsenic, As	L 0.001	L 0.001	mg/1
Cadmium, Cd	0.001	L 0.001	mg/1
Copper, Cu	0.02	0.06	mg/1
Lead, Pb	L 0.005	L 0.005	mg/1
Zinc, Zn	0.02	0.03	mg/1
Chromium, Cr	L 0.005	L 0.005	mg/1
Calcium, Ca	128.00	122.00	mg/1
Magnesium, Mg	105.00	110.00	mg/1
Hardness (CaCO3)	752.00	757.00	mg/1
Manganese, Mn	L 0.02	L 0.02	mg/1
Iron, Fe	0.10	0.04	mg/1
Sodium, Na	89.50	61.50	mg/1
Color	-	-	units
Turbidity	0.55	0.40	NTU
Cyanide, CN	L 0.02	L 0.02	mg/1
NO3-NO2-N	41.00	38.00	mg/1
Chloride, Cl	110.00	81.00	mg/1
Sulphate, SO4	165.00	110.00	mg/1
Coliform Group	L 1.00	31.00	per 100 ml
Fecal Coliform	-	L 1.00	per 100 ml

L = Less Than

G = Greater Than

Water Quality Analysis

Project: Phase II Landfill Study

Location: Stonewall, R.M. of Rockwood. NW-30-13-2E

Sample #: 2

Date: Result A; November 18, 1983 Result B; January 17, 1984

Parameter	Result A	Result B	Measured Unit
Conductivity	975.00	988.00	umho/cm
Residue Total	590.00	640.00	mg/l
Residue Filterable	590.00	640.00	mg/l
Residue Non Filterable	L 5.00	L 5.00	mg/l
pH	7.35	7.30	units
Alkalinity Total (CaCO3)	396.00	388.00	mg/l
Alkalinity (HCO3)	483.00	473.00	mg/l
Alkalinity (CO3)	0.00	0.00	mg/l
Alkalinity (OH)	0.00	0.00	mg/l
Arsenic, As	L 0.001	L 0.001	mg/l
Cadmium, Cd	L 0.001	L 0.001	mg/l
Copper, Cu	0.01	L 0.01	mg/l
Lead, Pb	L 0.005	L 0.005	mg/l
Zinc, Zn	L 0.01	L 0.01	mg/l
Chromium, Cr	L 0.005	L 0.005	mg/l
Calcium, Ca	80.00	85.30	mg/l
Magnesium, Mg	73.50	79.00	mg/l
Hardness (CaCO3)	503.00	538.00	mg/l
Manganese, Mn	L 0.02	L 0.02	mg/l
Iron, Fe	L 0.02	L 0.02	mg/l
Sodium, Na	21.10	23.20	mg/l
Color	-	-	units
Turbidity	0.40	0.25	NTU
Cyanide, CN	L 0.02	L 0.02	mg/l
NO3-NO2-N	10.40	10.60	mg/l
Chloride, Cl	53.00	52.00	mg/l
Sulphate, SO4	56.00	53.00	mg/l
Coliform Group	L 1.00	1.00	per 100 ml
Fecal Coliform	-	L 1.00	per 100 ml

L = Less Than

G = Greater Than

Water Quality Analysis

Project: Phase II Landfill Study.

Location: Stonewall, R.M. of Rockwood. NW-30-13-2E

Sample #: 3

Date: Result A; November 18. 1983 Result B; January 17, 1984

Parameter	Result A	Result B	Measured Unit
Conductivity	868.00	851.00	umho/cm
Residue Total	520.00	560.00	mg/l
Residue Filterable	520.00	560.00	mg/l
Residue Non Filterable	L 5.00	L 5.00	mg/l
pH	7.40	7.40	units
Alkalinity Total (CaCO3)	396.00	380.00	mg/l
Alkalinity (HCO3)	483.00	464.00	mg/l
Alkalinity (CO3)	0.00	0.00	mg/l
Alkalinity (OH)	0.00	0.00	mg/l
Arsenic, As	L 0.001	L 0.001	mg/l
Cadmium, Cd	L 0.001	L 0.001	mg/l
Copper, Cu	0.05	0.04	mg/l
Lead, Pb	L 0.005	L 0.005	mg/l
Zinc, Zn	L 0.01	L 0.01	mg/l
Chromium, Cr	0.012	L 0.005	mg/l
Calcium, Ca	65.00	71.40	mg/l
Magnesium, Mg	72.50	74.90	mg/l
Hardness (CaCO3)	461.00	487.00	mg/l
Manganese, Mn	L 0.02	L 0.02	mg/l
Iron, Fe	0.10	0.04	mg/l
Sodium, Na	8.77	10.00	mg/l
Color	-	-	units
Turbidity	0.60	0.30	NTU
Cyanide, CN	L 0.02	L 0.02	mg/l
NO3-NO2-N	10.60	10.20	mg/l
Chloride, Cl	21.00	22.00	mg/l
Sulphate, SO4	44.00	41.00	mg/l
Coliform Group	L 1.00	L 1.00	per 100 ml
Fecal Coliform	-	L 1.00	per 100 ml

L = Less Than

G = Greater Than

Water Quality Analysis

Project: Phase II Landfill Study

Location: Stonewall, R.M. of Rockwood, NW-30-13-2E

Sample #: 4

Date: Result A; November 18, 1983 Result B; January 17, 1984

Parameter	Result A	Result B	Measured Unit
Conductivity	946.00	891.00	umho/cm
Residue Total	590.00	590.00	mg/l
Residue Filterable	590.00	590.00	mg/l
Residue Non Filterable	L 5.00	L 5.00	mg/l
pH	7.25	7.00	units
Alkalinity Total (CaCO3)	396.00	384.00	mg/l
Alkalinity (HCO3)	483.00	468.00	mg/l
Alkalinity (CO3)	0.00	0.00	mg/l
Alkalinity (OH)	0.00	0.00	mg/l
Arsenic, As	L 0.001	L 0.001	mg/l
Cadmium, Cd	0.011	L 0.001	mg/l
Copper, Cu	0.05	L 0.01	mg/l
Lead, Pb	L 0.005	L 0.005	mg/l
Zinc, Zn	0.13	0.13	mg/l
Chromium, Cr	L 0.005	L 0.005	mg/l
Calcium, Ca	58.00	83.70	mg/l
Magnesium, Mg	68.00	68.30	mg/l
Hardness (CaCO3)	493.00	490.00	mg/l
Manganese, Mn	L 0.02	L 0.02	mg/l
Iron, Fe	L 0.02	L 0.02	mg/l
Sodium, Na	19.30	15.60	mg/l
Color	-	-	units
Turbidity	0.50	0.20	NTU
Cyanide, CN	L 0.02	L 0.02	mg/l
NO3-NO2-N	10.60	9.00	mg/l
Chloride, Cl	24.00	30.00	mg/l
Sulphate, SO4	74.00	47.00	mg/l
Coliform Group	L 1.00	L 1.00	per 100 ml
Fecal Coliform	-	L 1.00	per 100 ml

L = Less Than

G = Greater Than

Water Quality Analysis

Project: Phase II Landfill Study.

Location: Stonewall, R.M. of Rockwood. NW-30-13-2E

Sample #: 5

Date: Result A; November 18, 1983 Result B; January 17, 1984

Parameter	Result A	Result B	Measured Unit
Conductivity	960.00	897.00	umho/cm
Residue Total	590.00	550.00	mg/l
Residue Filterable	590.00	550.00	mg/l
Residue Non Filterable	L 5.00	L 5.00	mg/l
pH	7.30	7.40	units
Alkalinity Total (CaCO3)	398.00	386.00	mg/l
Alkalinity (HCO3)	486.00	471.00	mg/l
Alkalinity (CO3)	0.00	0.00	mg/l
Alkalinity (OH)	0.00	0.00	mg/l
Arsenic, As	L 0.001	L 0.001	mg/l
Cadmium, Cd	L 0.001	L 0.001	mg/l
Copper, Cu	1.25	0.08	mg/l
Lead, Pb	L 0.005	L 0.005	mg/l
Zinc, Zn	0.18	0.16	mg/l
Chromium, Cr	L 0.005	L 0.005	mg/l
Calcium, Ca	85.00	84.60	mg/l
Magnesium, Mg	68.00	68.60	mg/l
Hardness (CaCO3)	493.00	494.00	mg/l
Manganese, Mn	L 0.02	L 0.02	mg/l
Iron, Fe	0.03	0.41	mg/l
Sodium, Na	19.30	16.20	mg/l
Color	-	-	units
Turbidity	0.70	0.20	NTU
Cyanide, CN	L 0.02	L 0.02	mg/l
NO3-NO2-N	10.80	9.40	mg/l
Chloride, Cl	24.00	30.00	mg/l
Sulphate, SO4	75.00	47.00	mg/l
Coliform Group	L 1.00	L 1.00	per 100 ml
Fecal Coliform	-	L 1.00	per 100 ml

L = Less Than

G = Greater Than

Water Quality Analysis

Project: Phase II Landfill Study

Location: Stonewall, R.M.of Rockwood. NW-30-13-2E

Sample #: 6

Date: Result A; N/A Result B; January 17, 1984

Parameter	Result A	Result B	Measured Unit
Conductivity	-	769.00	umho/cm
Residue Total	-	470.00	mg/l
Residue Filterable	-	470.00	mg/l
Residue Non Filterable	-	L 5.00	mg/l
pH	-	7.30	units
Alkalinity Total (CaCO3)	-	364.00	mg/l
Alkalinity (HCO3)	-	444.00	mg/l
Alkalinity (CO3)	-	0.00	mg/l
Alkalinity (OH)	-	0.00	mg/l
Arsenic, As	-	L 0.001	mg/l
Cadmium, Cd	-	L 0.001	mg/l
Copper, Cu	-	0.30	mg/l
Lead, Pb	-	L 0.005	mg/l
Zinc, Zn	-	L 0.01	mg/l
Chromium, Cr	-	L 0.005	mg/l
Calcium, Ca	-	75.30	mg/l
Magnesium, Mg	-	62.70	mg/l
Hardness (CaCO3)	-	446.00	mg/l
Manganese, Mn	-	L 0.02	mg/l
Iron, Fe	-	0.02	mg/l
Sodium, Na	-	7.33	mg/l
Color	-	-	units
Turbidity	-	0.30	NTU
Cyanide, CN	-	L 0.02	mg/l
NO3-NO2-N	-	5.20	mg/l
Chloride, Cl	-	15.00	mg/l
Sulphate, SO4	-	28.00	mg/l
Coliform Group	-	L 1.00	per 100 ml
Fecal Coliform	-	L 1.00	per 100 ml

L = Less Than

G = Greater Than

3.10

LITTLE BLACK RIVER INDIAN RESERVE #9

WASTE DISPOSAL GROUND

50°50' NORTH 96°20'WEST

RUPERTSLAND ELECTORAL DIVISION

SELKIRK MAP SHEET 62 I #3

3.10 Little Black River Indian Reserve, Waste Disposal Ground

3.10.1 Location

The Little Black River Indian Reserve is located within the Rupertsland Electoral Division approximately 169 kilometres north-east of Winnipeg along the east shore of Lake Winnipeg. The waste disposal ground is located about 1.2 kilometres east of the Reserve townsite. The situation of the site is 50°50' north 96°20'west.

Figure A is an Electoral Division map locating the study area and the Little Black River Indian Reserve townsite within the Rupertsland Electoral Division.

3.10.2 Physiography

This region is characterized by deep basin sedimentary deposits forming extensive lake plains. These sediments are deposited in a pro-glacial or glacial environment creating a discontinuous veneer reflecting the form of the underlying bedrock topography.

Very little relief is found to the east of the disposal site. Frequent bedrock outcrops and some minor depressional swampy areas may be observed from place to place. West of the disposal site the surface relief is gently sloped toward the junction between the O'Hanly and Black Rivers. At the base of the slope, 471 metres west of the site, a small creek winds its way to the O'Hanly River. This creek represents the surficial drainage for the area in and around the waste disposal facility. Regional drainage is from east to west with the O'Hanly and Black Rivers entering Lake Winnipeg about 4.8 kilometres west of the disposal area.

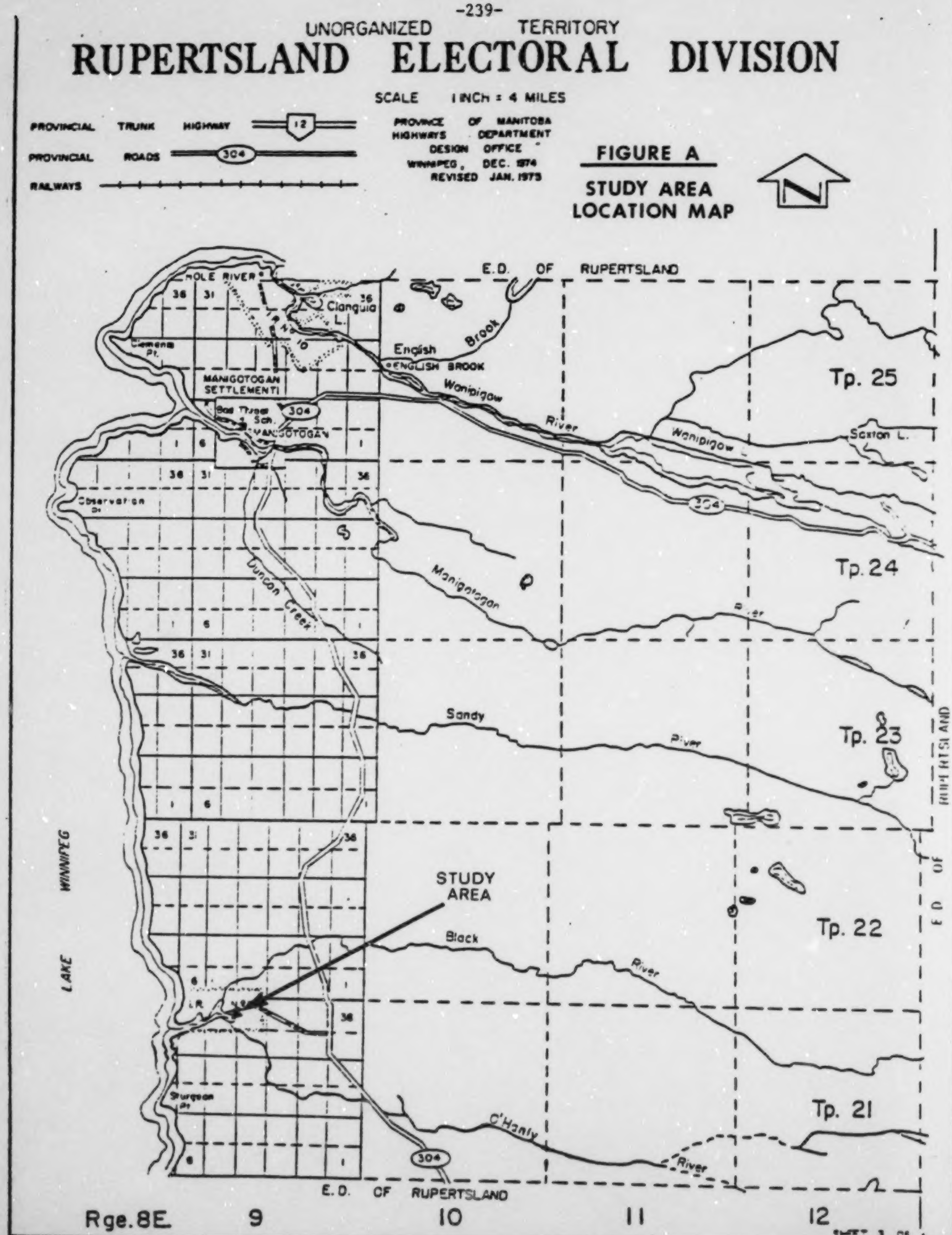


FIGURE A

STUDY AREA LOCATION MAP

UNORGANIZED TERRITORY
RUPERTSLAND ELECTORAL DIVISION
SCALE 1 INCH = 4 MILES
PROVINCIAL TRUNK HIGHWAY
12
PROVINCIAL ROADS
304
RAILWAYS
PROVINCE OF MANITOBA
HIGHWAYS DEPARTMENT
DESIGN OFFICE
WINNIPEG, DEC. 1974
REVISED JAN. 1975
N
E.D. OF RUPERTSLAND
HOLE RIVER
Clanguia L.
Clemens Pt.
English Brook
ENGLISH BROOK
MANIGOTOGAN SETTLEMENT
Wanipigow River
Wanipigow L.
Saxton L.
MANIGOTOGAN
304
Observation Pt.
Duncan Creek
Manigotogan River
Sandy River
Black River
O'Hanly River
Sturgeon Pt.
STUDY AREA
L.R.
LAKE WINNIPEG
Tp. 25
Tp. 24
Tp. 23
Tp. 22
Tp. 21
E.D. OF RUPERTSLAND
Rge. 8E
9
10
11
12

3.10.3 Site Conditions

During the site visit on August 12, 1983, a number of observations were made with regard to the Little Black River Indian Reserve waste disposal facility. Pictures taken during the site visit serve to illustrate the conditions in and around the active disposal area. These pictures can be found in Appendix A, along with a detailed description of each view.

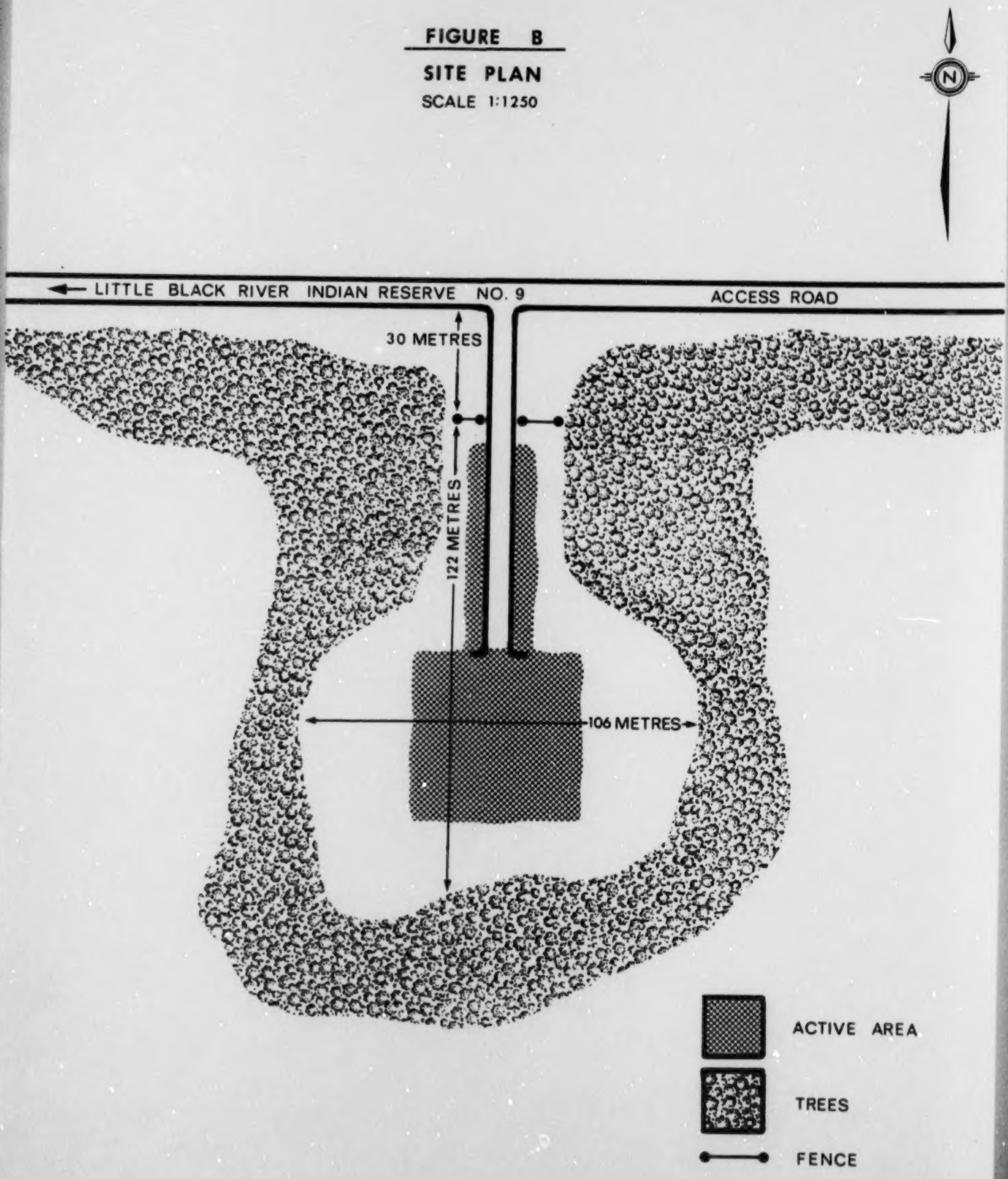
The disposal site covers an area of approximately 122 metres in length, (north to south), by 106 metres in width, (east to west). Access to the site is by a gravel road about 1.2 kilometres east of the townsite running south off the Little Black River Indian Reserve access road. A 1 metre high wire fence crosses the entrance to the site about 30 metres south of the Indian Reserve access road. A sign posted outside the fence gives instructions on the dumping procedures allowed at the waste disposal facility.

Surficial dumping is practiced at this particular site and the waste covers an area 45.6 metres square. Some waste dumping is carried out along the road leading up to the active area. From information obtained from phase one of this study and the initial site visit, it was learned that mostly municipal and domestic wastes are disposed of at this site. Burning of the waste is common practice and bulky metals are randomly distributed among the refuse. Animal remains found at the site were discarded with the other waste and no attempt at burial was evident. Figure B details the plan view of the site.

FIGURE B

SITE PLAN

SCALE 1:1250


N
LITTLE BLACK RIVER INDIAN RESERVE NO. 9
ACCESS ROAD
30 METRES
122 METRES
106 METRES
ACTIVE AREA
TREES
FENCE

3.10.4 Surficial Geology and Hydrogeology

In general the surficial geology around the Little Black River Indian Reserve waste disposal area can be directly related to a proglacial or glacial environment. Glaciolacustrine clays, silts, sands and some minor gravel were deposited in proglacial lakes. These deep basin deposits may range from 1 to 30 metres in thickness. In the area directly around the disposal site, however, up to 10 metres of clay underlain by till is suspected. Areas of iceberg scouring are common, with thin layers of alluvial deposits masking some of the underlying glacial debris. Wave washed till and exposed bedrock are also common occurrences in this setting.

The bedrock in this region is made up of granitic rocks which may contain some water bearing fractures. The only well reported on the reserve is set in granite. Some scattered sand and gravel lenses may provide small local aquifers.

The Water Resources Branch, Department of Natural Resources, Province of Manitoba was requested to complete a groundwater pollution hazard appraisal for the Little Black River Indian Reserve waste disposal facility. A copy of this appraisal can be found in Appendix B. Basically the comments made on the appraisal agree with the above general geology. This disposal area is not designated as a groundwater pollution hazard area.

Through discussions with the steering committee, it was decided that an in depth field investigation of this facility was not necessary due to the surficial geologic and hydrogeologic conditions in and around the disposal area.

3.10.5 Groundwater Sampling

Because of the suspected thick layer of impermeable clay overlying the granitic bedrock, the installation of groundwater monitoring wells was not necessary at this site. Sampling of local water supplies was not undertaken because the only reported well in the area is fairly close to the townsite which is 1.2 kilometres west of the disposal facility. It was felt that 1.2 kilometres, in these surficial soil conditions was sufficient distance to eliminate the concern over groundwater aquifer pollution of domestic water supplies.

Figure C is an air photo of the study area at a scale of 1:15840. This photo shows the location of the disposal site with respect to the Little Black River Indian Reserve townsite.

3.10.6 Analytical Results and Conclusions

With regard to the Little Black River Indian Reserve waste disposal facility and the phase two assessment of the site, there is no observed effect on the surrounding environment. Data collected throughout the study shows no hazard to the public health which can be directly related to the waste disposal ground.

Groundwater

Because this site is not considered to be in a groundwater pollution hazard area and it is located on mainly impermeable or very low permeability materials, aquifer pollution by leachates from the Little Black River Indian Reserve waste disposal ground is not of concern.

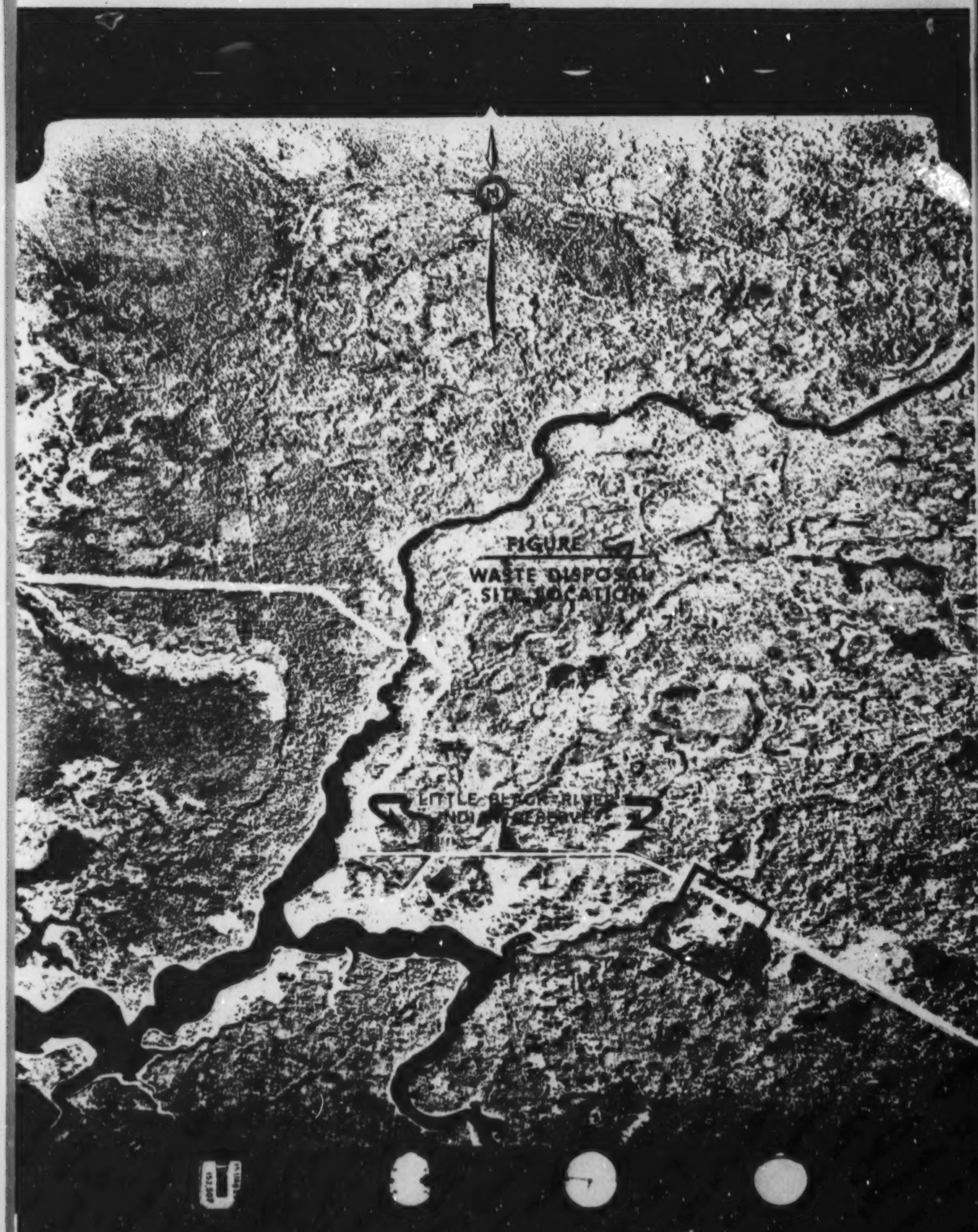


FIGURE [illegible]

WASTE DISPOSAL SITE LOCATION

N
LITTLE BLACK RIVER
INDIAN RESERVE

Methane

Methane gas produced through the decomposition of buried domestic wastes can be of concern to buildings located in close proximity to waste disposal sites. In this case, however, because of the method of operation, surface disposal without cover and the distance to the nearest dwelling 400 metres, methane production, if any, is not of concern.

Surface Water

Surface water pollution from the waste disposal ground is not likely to occur at this particular site. The nearest body of water is a small creek approximately 471 metres west of the site. Normally, because this creek is downgrade from the site and serves as the surficial drainage for the area, some concern would be raised over leachate runoff to the creek, but because the site is fairly small surface water pollution from this site is not of concern.

3.10.7 Recommendations

1) Dead livestock deposited in the waste disposal area should be burried within 24 hours of deposit with a minimum of 1 meter of earthen cover.
2) All bulky metals should be stored in a separate, above grade compound away from the active disposal area.
3) Refer to Manitoba Regulation 208/76 under the Clean Environment Act for further clarification of these recommendations and other waste disposal ground operating procedures.

4) In the case of a facility under federal jurisdiction such as an Indian Reserve waste disposal site, reference to federal regulations governing waste disposal grounds is advised.

APPENDIX A

Date: August 12, 1983 Location: L.B.R. Waste Disposal Ground

Orientation: Taken from the L.B.R. access road looking south.

Comments: View of the site entrance. Dumping procedures are outlined on the sign. Dumping of waste continues along roadway to the active area.

Date: August 12, 1983 Location: L.B.R. Waste Disposal Ground

Orientation: Taken from the site access road looking south.

Comments: Surficial dumping and burning seems to be the practice here. Bulk metals are not separated from the other waste.

APPENDIX B

FILE NO. 5.7.4.2.

WATER RESOURCES BRANCH

GROUNDWATER POLLUTION HAZARD APPRAISAL

POTENTIAL SOURCE OF POLLUTION	Waste Disposal Ground
LOCATION OF SOURCE	Map 62I, 50° 50 N 96° 20 W
OWNER OF SOURCE	Little Back River Indian Reserve

GEOLOGICAL CONDITIONS	SURFICIAL DEPOSITS	From zero to 10 m of clay, in places, underlain by till.
	BEDROCK	Granitic rocks.

GROUNDWATER CONDITIONS	AQUIFERS	The granitic rock may contain water bearing fractures. Isolated pockets of sand and gravel may form a few scattered aquifers.
	WELLS	Only one well reported on the reserve; it is in granite.

POLLUTION HAZARD

If the disposal ground is in a clayey area, groundwater pollution by leachates is not likely.

COMMENTS

It would be advisable to locate the waste disposal ground at least 500 m from wells or potential well sites.

BY: M. Rutulis, P. Eng.
GROUNDWATER GEOLOGIST

DATE: Dec. 7, 1983

3.11

RAPID CITY WASTE DISPOSAL GROUND

SE-30-13-19W

R.M. OF SASKATCHEWAN #1

3.11 Rapid City Waste Disposal Ground

3.11.1 Location

The Town of Rapid City, Manitoba is located within the Rural Municipality of Saskatchewan, approximately 196 kilometres west of Winnipeg along P.T.H. 24. The waste disposal area is located about 627 metres north-west of the town and the legal description is SE-30-13-19W.

Figure A is a Rural Municipality map locating the study area and the Town of Rapid City within the Rural Municipality of Saskatchewan.

3.11.2 Physiography

This region is characterized by the gently sloping walls of the Little Saskatchewan River Valley. This particular disposal site is located on the north side of the river about 1/4 of the way up the valley slope, overlooking the Town of Rapid City. The site itself is set in a small natural depression which is a common feature of the valley walls in this area.

Surficial drainage for this area is down the valley to the Little Saskatchewan River. Some small drainage channels are evident running down the slopes of the valley, but these would only be active during times of heavy runoff, such as spring thaw or during very heavy rains. Regional drainage for the area is from north to south.

№.90

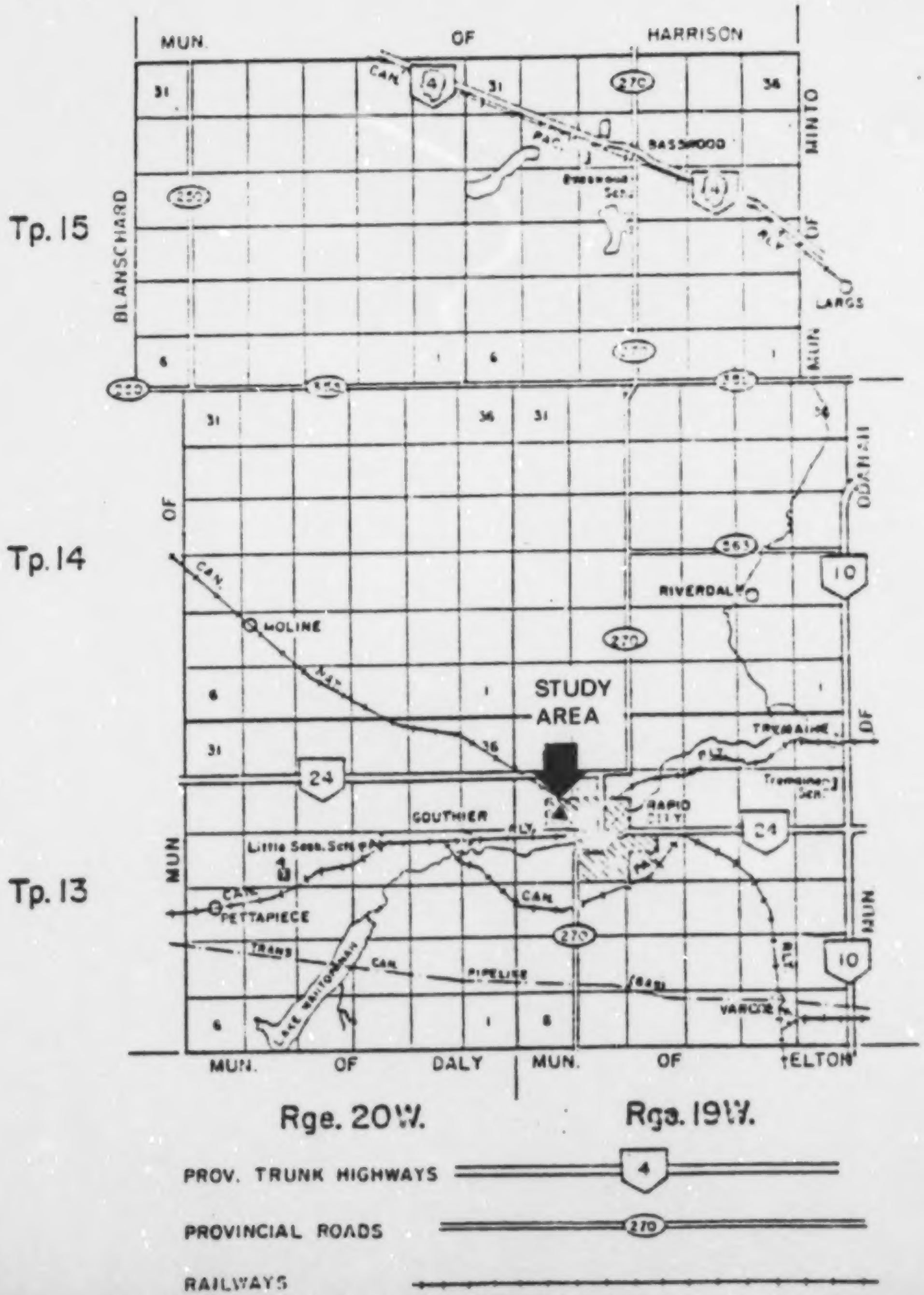
MUN. OF SASKATCHEWAN

PROVINCE OF MANITOBA
HIGHWAYS DEPARTMENT
DESIGN OFFICE
WPG., NOV.,1969

SCALE: 1in. = 3mi.

FIGURE A

STUDY AREA LOCATION MAP


MUN. OF HARRISON
BLANSCHARD
MINTO
MUN. OF MINTO
ODANAH
MUN. OF ODANAH
Tp. 15
Tp. 14
Tp. 13
BASSWOOD
LARGS
RIVERDALE
MOLINE
CAN. NAT.
CAN. PAC.
STUDY AREA
24
10
4
270
250
353
GOUTHIER
RAPID CITY
TREMAINE
PETTAPIECE
LAKE WAHTOPANAH
TRANS CAN. PIPELINE
VARCOE
MUN. OF DALY
MUN. OF ELTON
Rge. 20W.
Rge. 19W.
PROV. TRUNK HIGHWAYS
PROVINCIAL ROADS
RAILWAYS

3.11.3 Site Conditions

During the site visit on August 19, 1983, a number of observations were made with regard to the Rapid City waste disposal facility. Pictures taken during the site visit serve to illustrate the conditions in and around the active area of disposal. These pictures can be found in Appendix A, along with a detailed description of each view.

The disposal site covers an area of approximately 122 metres in length, (east to west), by 40 metres in width, (north to south). This area is not fenced or treed and the vegetation present is high prairie grass and small shrubs. Access to the area is by gravel road about .6 kilometres west of Rapid City running north off Saskatchewan Avenue. A sign at the entrance to the access road identifies the waste disposal area.

The active dump area is in a natural topographic depression. Here the waste is discarded, burned and than covered. The working face of the disposal site is moving from east to west filling this depression. Approximately 1/3 of this area has already been leveled in with waste and covered. The active dump area is the remainder of this natural depression, 76 metres long by 36 metres wide. From the information gathered during phase one of this study it was learned that various types of municipal and domestic wastes, including chemical cans and construction materials are disposed of at this site.

While at the site it was observed that many pesticide containers had been deposited in the active pit. Burning of the waste was evident and bulky metals were disposed of in the active area. There was no cover or fill material in evidence at this disposal facility. Evidence of soil moisture and the presence of swamp type grasses at the western end of the disposal depression indicate that water may be contained in this area from time to time. Figure B details the plan view of the site.

3.11.4 Surficial Geology and Hydrogeology

In general the surficial geology around the Rapid City waste disposal area can be directly related to a non-glacial environment. Glacial till material 1 to 30 metres thick, made up of clay, silt, sand and gravel is common. These alluvial sediments have been deposited in what can be described as a glacial spillway, which has now become the Little Saskatchewan River Valley. Very few sand and gravel lenses are found interbedded within the till around this disposal site.

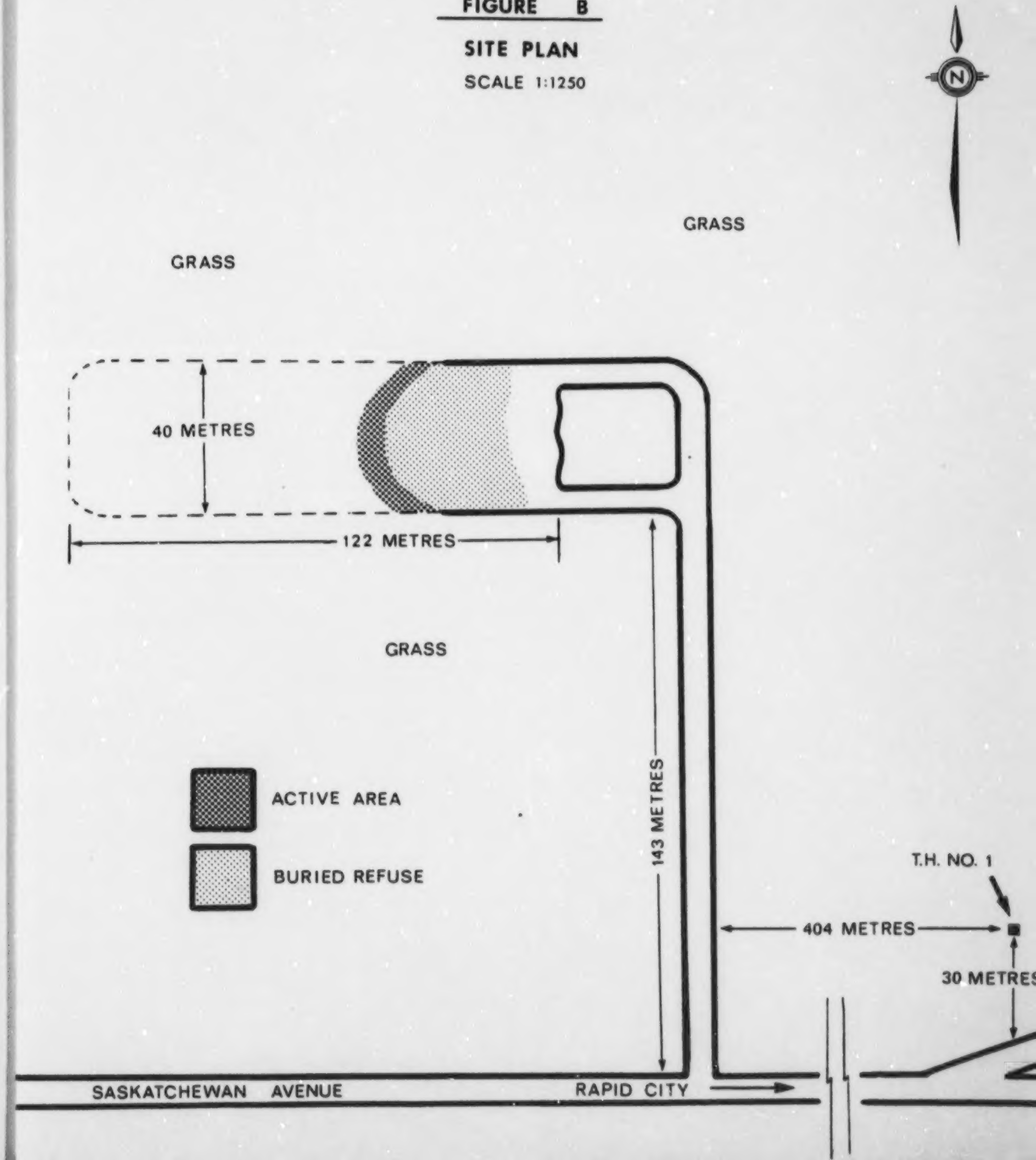
The bedrock in the area is commonly shale. Very little fracturing occurs in the upper shale, therefore, groundwater movement in this zone is minimal. The only groundwater producing wells in this area are in the shallow sand and gravel aquifers which exist in the bottom part of the Little Saskatchewan River Valley, south-east of the disposal facility.

The Water Resources Branch, Department of Natural Resources, Province of Manitoba was requested to complete a groundwater pollution hazard appraisal for the Rapid City waste disposal facility. A copy

FIGURE B

SITE PLAN

SCALE 1:1250


N
GRASS
GRASS
40 METRES
122 METRES
GRASS
ACTIVE AREA
BURIED REFUSE
143 METRES
T.H. NO. 1
404 METRES
30 METRES
SASKATCHEWAN AVENUE
RAPID CITY

of this appraisal can be found in Appendix B. Basically the comments made on the appraisal agree with the above general geology. The disposal site is not designated as a groundwater pollution hazard area because there are no known groundwater producing aquifers in or around the area of disposal.

Through discussion with the steering committee it was decided that a field investigation, including test drilling and monitoring well installation, would take place because of the gradient of the land and the proximity of local residences. This field investigation would confirm surficial geologic conditions between the waste disposal site and the the residences down gradient from the waste facility.

On November 1, 1983, one 12 metre deep test hole was drilled near Rapid City waste disposal ground using the mud rotary drilling method. Because of the amount of gravel and boulders encountered in the upper till formation and the reported shallow depths of nearby wells, it was decided to install a monitoring well in the test hole to recover groundwater samples. T.H. #1 was drilled to 12 metres for geologic confirmation. Because of the lower clay till formation, the 51 mm I.D. monitoring well at T.H. #1 was set to 5.5 metres with the last 2 metres slotted and wrapped with fiberglass well screening material. A geologic log of the test hole drilled can be found in Appendix C. Soil samples taken during the test drilling program have been retained for future reference. The test hole location can be found on Figure B.

3.11.5 Groundwater Sampling

On November 1, 1983, and again on January 11, 1984, groundwater samples were collected from two residences south-east of the disposal area and the installed monitoring well. These samples were submitted to the W. M. Ward Technical Services Laboratory for analyses. Bacteriological samples were submitted to the Cadham Provincial Laboratory for testing. The results of these analyses can be found in Appendix D.

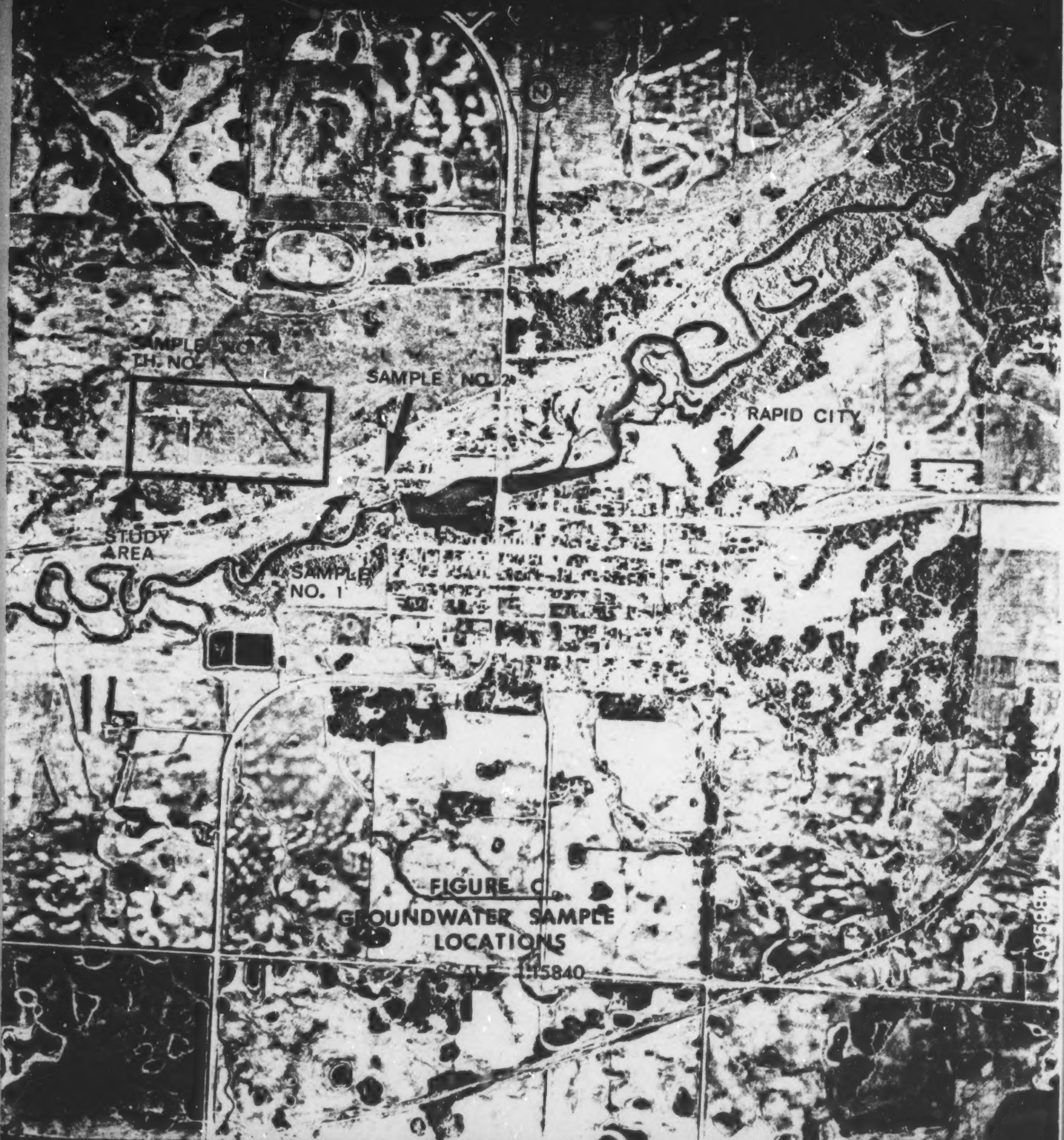
Figure C is an air photo of the study area at a scale of 1:15840. This photo shows the location of the disposal site with respect to the Town of Rapid City. The groundwater sampling points established during the field investigation of this waste disposal site have been located on this air photo.

3.11.6 Analytical Results and Conclusions

With regard to the Rapid City waste disposal facility and the phase two assessment of the site, there is no observed effect on the surrounding environment. Data collected throughout the study shows no hazard to the public health which can be directly attributed to the waste disposal ground.

Groundwater

Because the nearest residences to the Rapid City waste disposal ground are down gradient and the wells reported at these



N
SAMPLE NO.
T.H. NO. 1
SAMPLE NO. 2
RAPID CITY
STUDY AREA
SAMPLE NO. 1

FIGURE C
GROUNDWATER SAMPLE LOCATIONS
SCALE 1:15840

residences are fairly shallow, a test drilling program was established to identify the surficial geologic and hydrogeologic conditions between the disposal site and these dwellings. Surficial deposits in this area contain a high percentage of clays and are therefore fairly impermeable. Up to 30 metres of this glacial clay till overlies the hard shale bedrock common to this region. Very little water was available in the monitoring well installed in this till material. Domestic water supplies south-east of the disposal area are drawn from shallow sand and gravel aquifers in the lower part of the Little Saskatchewan River Valley. These aquifers are not encountered farther up the valley slope where the waste disposal ground is situated.

Water quality analyses conducted on two local domestic water supplies and the installed monitoring well were compared to the "Guidelines for Canadian Drinking Water Quality" prepared by Health and Welfare Canada in 1978. These groundwater supplies can be described in general as good quality for domestic purposes.

These test drilling observations and laboratory results indicate that groundwater contamination is not a problem with respect to the Rapid City waste disposal facility.

Methane

Methane gas produced through the decomposition of buried domestic waste can be of concern to buildings located in close proximity to waste disposal sites. In this case however, because of the soil conditions and the distance to the nearest dwelling, approximately 527 metres, methane production if any is not a concern.

It should be noted that explosimeter tests for methane gas were conducted during the test drilling program and at each sampling of the monitoring well, no positive readings were recorded.

Surface Water

Surface water pollution from the waste disposal ground is not likely to occur at this particular site. Pollution from groundwater migration to surface water is not going to occur because of the surficial soil characteristics in and around the site. The nearest body of water is the Little Saskatchewan River 500 metres south of the disposal site. Normally because the river is downgrade from the disposal ground and the surficial drainage for this region is toward the river, some concern could be raised over leachate runoff to this body of water. In this case surficial runoff of contaminants from the disposal ground to the Little Saskatchewan River is not of concern because of the small size of the site and the distance to the river.

3.11.7 Recommendations

1) All pesticide containers should be drained, crushed and stored in a separate area away from the active disposal trench. Crushing the containers reduces the size of storage area required to hold the empty cans. Draining the cans reduces the risk of environmental pollution from pesticide residues. All drainings should be collected and disposed of in an approved manner.
2) All bulky metals should be stored in a separate, above grade compound away from the active area.

It should be noted that explosimeter tests for methane gas were conducted during the test drilling program and at each sampling of the monitoring well, no positive readings were recorded.

Surface Water

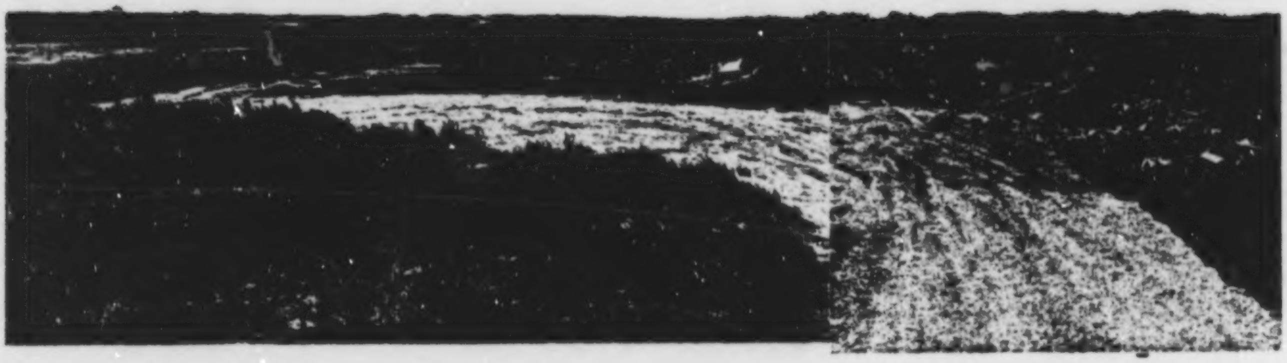
Surface water pollution from the waste disposal ground is not likely to occur at this particular site. Pollution from groundwater migration to surface water is not going to occur because of the surficial soil characteristics in and around the site. The nearest body of water is the Little Saskatchewan River 500 metres south of the disposal site. Normally because the river is downgrade from the disposal ground and the surficial drainage for this region is toward the river, some concern could be raised over leachate runoff to this body of water. In this case surficial runoff of contaminants from the disposal ground to the Little Saskatchewan River is not of concern because of the small size of the site and the distance to the river.

3.11.7 Recommendations

1) All pesticide containers should be drained, crushed and stored in a separate area away from the active disposal trench. Crushing the containers reduces the size of storage area required to hold the empty cans. Draining the cans reduces the risk of environmental pollution from pesticide residues. All drainings should be collected and disposed of in an approved manner.
2) All bulky metals should be stored in a separate, above grade compound away from the active area.

3) Refer to Manitoba Regulation 208/76 under the Clean Environment Act for further clarification of these recommendations and other waste disposal ground operating procedures.

APPENDIX A



Date: August 19, 1983 Location: Rapid City Waste Disposal Ground

Orientation: Taken from the site access road looking west.

Comments: The waste is burned and than pushed into a small natural depression and covered. The graded area in the center of this picture represents waste which has already been compacted.

Date: August 12, 1983 Location: Rapid City Waste Disposal Ground

Orientation: Taken from the active face looking west.

Comments: Bulk metals and pesticide containers are not separated from the active area. The depression into which the waste is deposited can be seen in the uper center of this photograph.

Date: August 12, 1983 Location: Rapid City Waste Disposal Ground

Orientation: Taken from the disposal depression looking east.

Comments: Note the moist soil and swamp type grasses located at the base of the depression. The waste is moving from east to west along this topographic low.

Date: November 1, 1983 Location: Rapid City Waste Disposal Ground

Orientation: Taken from Saskatchewan Avenue looking north.

Comments: Drilling of test hole #1. A monitoring well was installed at this site.

APPENDIX B

FILE No. 5.7.4.2.

WATER RESOURCES BRANCH

GROUNDWATER POLLUTION HAZARD APPRAISAL

POTENTIAL SOURCE OF POLLUTION	Waste Disposal Ground
LOCATION OF SOURCE	SE3-13-19W
OWNER OF SOURCE	R.M. of Saskatchewan, Rapid City

GEOLOGICAL CONDITIONS	SURFICIAL DEPOSITS	Up to 30 m of glacial till with a few lenses of sand and gravel.
	BEDROCK	Shale.

GROUNDWATER CONDITIONS	AQUIFERS	Some of the lenses of sand and gravel may be water bearing.
	WELLS	No wells reported on this section. Shallow wells in sand and gravel aquifers exist in the bottom part of Little Saskatchewan River Valley south and east of this quarter-section.

POLLUTION HAZARD

Because there are practically no aquifers on this section, aquifer pollution by leachates from the waste disposal ground is not likely.

COMMENTS

Because the municipal wells are located south of the Little Saskatchewan River, leachates from the waste disposal ground, which is north of the River, are not likely to affect the municipal water supply.

BY: M. Rutulis, P. Eng.
GROUNDWATER GEOLOGIST

DATE: Dec. 7, 1983.

APPENDIX C

GEOLOGIC LOG

Test Hole Identification: Rapid City T.H. #1

Location: Rapid City, Manitoba. R.M. of Saskatchewan

Legal Description: SW-29-13-19W

Date: November 2, 1983

Time: 8:30 A.M. to 11:20 P.M.

Total Depth: 12 Metres

Type Of Casing: Series 160, Plastic

Type Of Screen: Slotted, Fiberglass Wrap

Depth	Description
0 to 1.5 m.	Heavy gravel, lots of brown clay till, some boulders.
1.5 to 3 m.	Brown clay till, large boulders.
3 to 4.6 m.	Dark gray clay till.
4.6 to 12.2 m.	Dark gray clay till, less stones and boulders with depth.

APPENDIX D

Water Quality Analysis

Project: Phase II Landfill Study

Location: Rapid City, R.M. of Saskatchewan. NW-20-13-19W

Sample #: 1

Date: Result A; November 2, 1983 Result B; January 11, 1984

Parameter	Result A	Result B	Measured Unit
Conductivity	1440.00	1390.00	umho/cm
Residue Total	970.00	970.00	mg/l
Residue Filterable	970.00	970.00	mg/l
Residue Non Filterable	L 5.00	L 5.00	mg/l
pH	7.40	7.30	units
Alkalinity Total (CaCO3)	442.00	436.00	mg/l
Alkalinity (HCO3)	539.00	532.00	mg/l
Alkalinity (CO3)	0.00	0.00	mg/l
Alkalinity (OH)	0.00	0.00	mg/l
Arsenic, As	L 0.001	L 0.001	mg/l
Cadmium, Cd	L 0.001	L 0.001	mg/l
Copper, Cu	0.91	0.31	mg/l
Lead, Pb	L 0.005	L 0.005	mg/l
Zinc, Zn	1.44	1.24	mg/l
Chromium, Cr	L 0.005	L 0.005	mg/l
Calcium, Ca	148.00	141.C0	mg/l
Magnesium, Mg	87.00	82.50	mg/l
Hardness (CaCO3)	728.00	692.00	mg/l
Manganese, Mn	L 0.02	L 0.02	mg/l
Iron, Fe	0.09	0.16	mg/l
Sodium, Na	46.30	39.80	mg/l
Color	-	-	units
Turbidity	0.55	0.55	NTU
Cyanide, CN	L 0.02	L 0.02	mg/l
NO3-NO2-N	3.60	2.80	mg/l
Chloride, Cl	81.00	55.00	mg/l
Sulphate, SO4	215.00	230.00	mg/l
Coliform Group	-	L 1.00	per 100 ml
Fecal Coliform	-	L 1.00	per 100 ml

L = Less Than

G = Greater Than

Water Quality Analysis

Project: Phase II Landfill Study.

Location: Rapid City, R.M. of Saskatchewan. NW-20-13-19W

Sample #: 2

Date: Result A; November 2, 1983 Result B; January 11, 1984

Parameter	Result A	Result B	Measured Unit
Conductivity	1700.00	1640.00	umho/cm
Residue Total	1170.00	1150.00	mg/1
Residue Filterable	1170.00	1150.00	mg/1
Residue Non Filterable	L 5.00	L 5.00	mg/1
pH	7.35	7.30	units
Alkalinity Total (CaCO3)	498.00	516.00	mg/1
Alkalinity (HCC3)	608.00	630.00	mg/1
Alkalinity (CO3)	0.00	0.00	mg/1
Alkalinity (OH)	0.00	0.00	mg/1
Arsenic, As	L 0.001	L 0.001	mg/1
Cadmium, Cd	L 0.001	L 0.001	mg/1
Copper, Cu	0.21	0.09	mg/1
Lead, Pb	L 0.005	L 0.005	mg/1
Zinc, Zn	0.53	0.05	mg/1
Chromium, Cr	L 0.005	L 0.005	mg/1
Calcium, Ca	168.00	173.00	mg/1
Magnesium, Mg	106.00	108.00	mg/1
Hardness (CaCO3)	856.00	877.00	mg/1
Manganese, Mn	L 0.02	L 0.02	mg/1
Iron, Fe	0.08	0.11	mg/1
Sodium, Na	73.00	70.80	mg/1
Color	-	-	units
Turbidity	0.45	0.45	NTU
Cyanide, CN	L 0.02	L 0.02	mg/1
NO3-NO2-N	3.40	1.60	mg/1
Chloride, Cl	140.00	118.00	mg/1
Sulphate, SO4	260.00	265.00	mg/1
Coliform Group	-	L 1.00	per 100 ml
Fecal Coliform	-	L 1.00	per 100 ml

L = Less Than

G = Greater Than

Water Quality Analysis

Project: Phase II Landfill Study

Location: Rapid City, R.M. of Saskatchewan, SW-29-13-19W

Sample #: 3

Date: Result A; November 2, 1983 Result B; January 11, 1984

Parameter	Result A	Result B	Measured Unit
Conductivity	1390.00	2140.00	umho/cm
Residue Total	-	-	mg/l
Residue Filterable	-	1810.00	mg/l
Residue Non Filterable	-	-	mg/l
pH	8.30	7.65	units
Alkalinity Total (CaCO3)	284.00	344.00	mg/l
Alkalinity (HCO3)	346.00	420.00	mg/l
Alkalinity (CO3)	0.00	0.00	mg/l
Alkalinity (OH)	0.00	0.00	mg/l
Arsenic, As	0.001	0.001	mg/l
Cadmium, Cd	L 0.001	L 0.001	mg/l
Copper, Cu	0.04	0.08	mg/l
Lead, Pb	L 0.005	L 0.005	mg/l
Zinc, Zn	0.03	0.10	mg/l
Chromium, Cr	0.005	0.006	mg/l
Calcium, Ca	119.00	195.00	mg/l
Magnesium, Mg	52.40	81.90	mg/l
Hardness (CaCO3)	513.00	825.00	mg/l
Manganese, Mn	0.14	0.60	mg/l
Iron, Fe	0.31	0.20	mg/l
Sodium, Na	148.00	231.00	mg/l
Color	-	-	units
Turbidity	-	-	NTU
Cyanide, CN	-	-	mg/l
NO3-NO2-N	1.38	7.00	mg/l
Chloride, Cl	34.00	41.00	mg/l
Sulphate, SO4	400.00	870.00	mg/l
Coliform Group	-	-	per 100 ml
Fecal Coliform	-	-	per 100 ml

L = Less Than

G = Greater Than

3.12

SHELLMOUTH WASTE DISPOSAL GROUND

SW-33-22-29W

R.M. OF SHELLMOUTH #4

3.12 Shellmouth Waste Disposal Ground

3.12.1 Location

The community of Shellmouth, Manitoba is located within the Rural Municipality of Shellmouth, approximately 322 kilometres north-west of Winnipeg along P.R. 482. The waste disposal area is located about 1.4 kilometres west of the Community and the legal description is SW-33-22-29W.

Figure A is a Rural Municipality Map locating the study area and the Community of Shellmouth within the Rural Municipality of Shellmouth.

3.12.2 Physiography

This region is characterized by the steep valley walls of the Assiniboine River Valley. This particular disposal site is located on the valleys' eastern bluff overlooking the Assiniboine River and the Town of Shellmouth.

Surficial drainage for this area is down the valley to the Assiniboine River. Some small drainage channels are evident running down the slopes of the valley but these would only be active during times of high surficial runoff, such as, spring thaw or during very heavy rains. Regional drainage for this area is from east to west.

3.12.3 Site Conditions

During the site visit on August 23, 1983, a number of

Nº 91

MUN. OF SHELLMOUTH

PROVINCE OF MANITOBA
DEPARTMENT OF TRANSPORTATION
DESIGN OFFICE
WINNIPEG, OCT., 1969
Scale: 1" = 3 Miles.

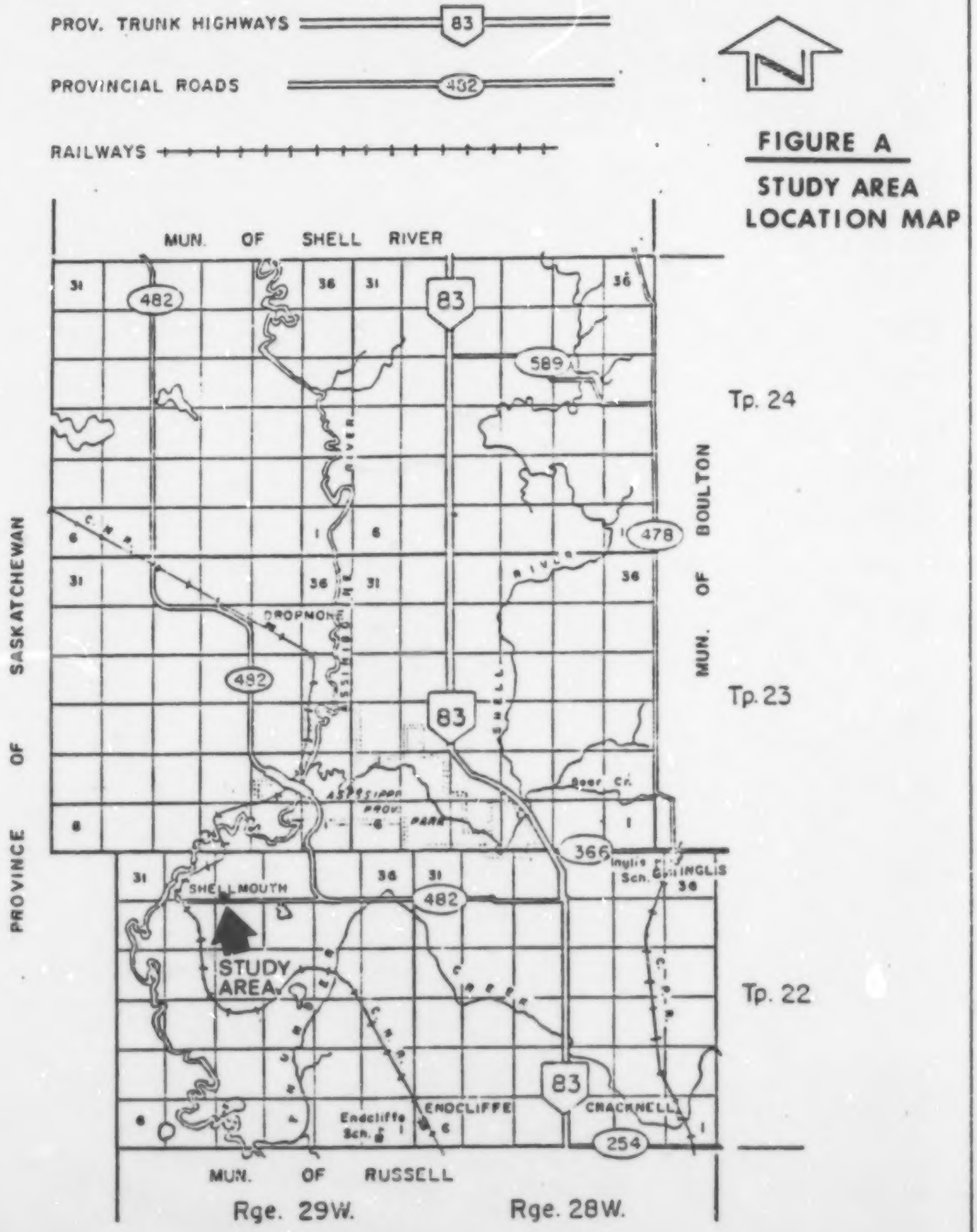

PROV. TRUNK HIGHWAYS
83
PROVINCIAL ROADS
482
RAILWAYS
MUN. OF SHELL RIVER
482
83
589
Tp. 24
RIVER
478
MUN. OF BOULTON
C.N.R.
DROPMORE
ASSINIBOINE
SHELL
RIVER
482
83
Tp. 23
PROVINCE OF SASKATCHEWAN
ASESSIPPI PROV. PARK
Boar Cr.
366
Inglis Scn.
INGLIS
SHELLMOUTH
482
STUDY AREA
Tp. 22
C.N.R.
83
Endcliffe Scn.
ENDCLIFFE
CRACKNELL
254
MUN. OF RUSSELL
Rge. 29W.
Rge. 28W.
31
36
31
36
6
1
6
31
36
31
36
6
1
31
36
31
36
6
1
N

FIGURE A

STUDY AREA LOCATION MAP

observations were made with regard to the Shellmouth waste disposal facility. Pictures taken during the site visit serve to illustrate the conditions in and around the area of active disposal. These pictures can be found in Appendix A. Along with a detailed description of each view.

The disposal site covers an area of approximately 50 metres in length, (north to south), by 56 metres in width, (east to west). There is no fence around the disposal area but trees completely surround and conceal the site. Access to the area is by gravel road running west off P.R. 482, about 1.5 kilometres east of Shellmouth. There are no signs identifying the site or indicating disposal procedures at this facility.

The active dump area is a pit 33.4 metres long by 7.3 metres wide and approximately 2 metres deep. From information gathered during phase one of this study and the initial site visit, it was learned that mostly municipal wastes are disposed of at this site.

While at the site it was observed that about 50 pesticide containers had been deposited in the trench. Some burning of the waste was evident and no liquid residue was in the pit at the time of the inspection. Some animal carcasses were also noticed. Figure B. details the plan view of the site.

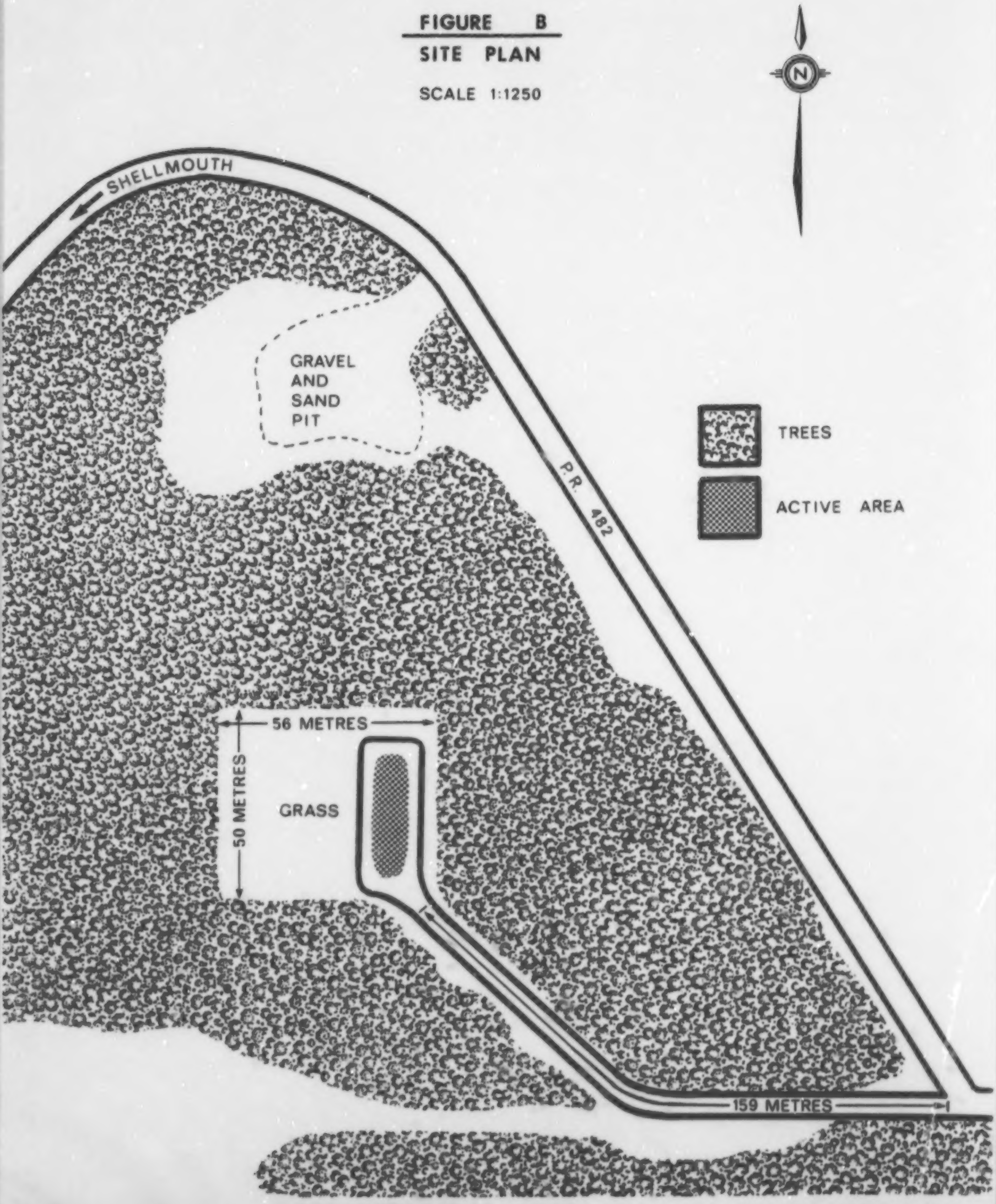
3.12.4 Surficial Geology and Hydrogeology

In general the surficial geology around the Shellmouth waste disposal area can be directly related to a proglacial or glacial environment. Glaciofluvial deposits 1 to 30 metres thick are common

FIGURE B

SITE PLAN

SCALE 1:1250


N
SHELLMOUTH
GRAVEL
AND
SAND
PIT
P.R. 482
TREES
ACTIVE AREA
56 METRES
50 METRES
GRASS
159 METRES

for this area. Clay, silt, sand and some minor amounts of gravel were deposited in an ice marginal environment. There are some indications of outwash deposition and glacial valley fill in the vacinity of the disposal site. Some fairly thick localized sand and gravel deposits are located about 527 metres north of the waste disposal site at the base of the east valley bluff.

The bedrock in this area is commonly soft clayey shale, which has a particularly low permeability. Except for minor surficial lenses which contain little or no water, groundwater use in this area is confined to shallow wells at the base of the valley 1 kilometer west of the disposal site.

The Water Resources Branch, Department of Natural Resources, Province of Manitoba was requested to complete a groundwater pollution hazard appraisal for the Shellmouth waste disposal facility. A copy of this appraisal can be found in Appendix B. Basically the comments made on the appraisal agree with the above general geology. This disposal area is not designated as a groundwater pollution hazard area.

Through discussions with the steering committee, it was decided that an in depth field investigation of this facility was not necessary due to the surficial geologic and hydrogeologic conditions in and around the disposal area.

3.12.5 Groundwater Sampling

Because of the thick impermeable layers of clay till and the soft clayey shale bedrock, the installation of groundwater monitoring wells was not necessary at this site. Sampling of local water supplies was not undertaken because there are not any groundwater wells within 1 kilometre of the active disposal area. It was felt that 1 kilometre in these surficial soil conditions was enough distance to eliminate the concern over groundwater aquifer pollution of domestic water supplies.

Figure C is an air photo of the study area at a scale of 1:15840. This photo shows the location of the disposal site with respect to the Town of Shellmouth.

3.12.6 Analytical Results and Conclusions

With regard to the Shellmouth waste disposal facility and the phase two assessment of the site, there is no observed effect on the surrounding environment. Data collected throughout the study shows no hazard to the public health which can be directly attributed to the waste disposal ground.

Groundwater

Because this site is not considered to be in a groundwater pollution hazard area and it is located on mainly impermeable or very low permeability materials, aquifer pollution by leachates from the Shellmouth waste disposal ground is not of concern.

Methane

Methane gas produced through the decomposition of buried domestic waste can be of concern to buildings located in close proximity to waste disposal sites. In this case however, because of the soil conditions and the distance to the nearest dwelling, approximately 1.4 kilometres, methane production, if any, is not of concern.

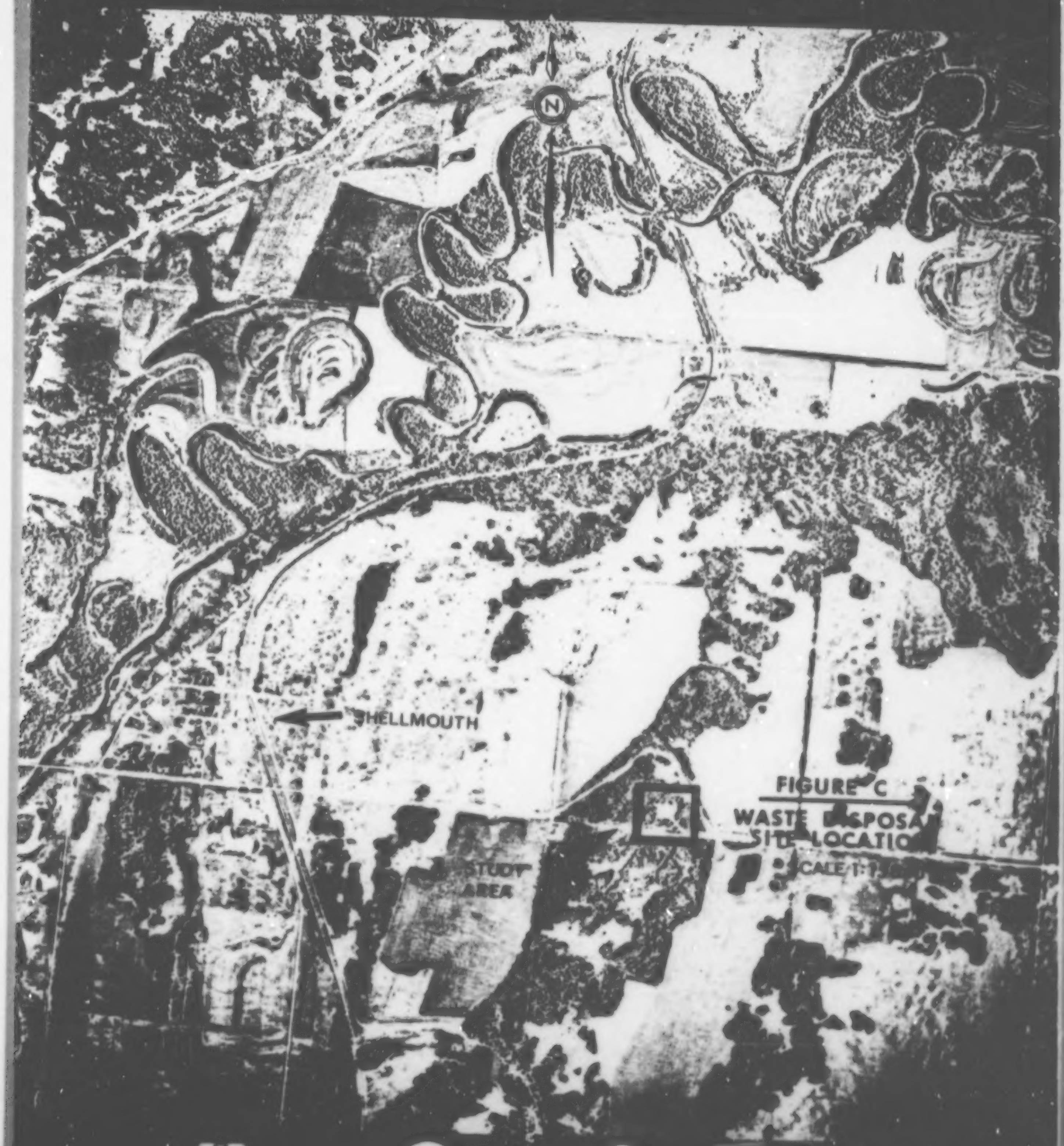

N
SHELLMOUTH
STUDY AREA

FIGURE C
WASTE DISPOSAL SITE LOCATION
SCALE 1:1

Surface Water

Surface water pollution from the waste disposal ground is not likely to occur at this particular site. The nearest body of water is the Assiniboine River approximately 1.8 kilometres west of the disposal site. Because of the surficial soil conditions at the Shellmouth facility, the type of disposal operation, trench and fill and the distance to the Assiniboine River, surface water pollution at this site is not of concern.

3.12.7 Recommendations

1) All pesticide containers should be drained, crushed and stored in a separate area away from the active disposal trench. Crushing the containers reduces the size of the storage area required to hold the empty cans. Draining the cans reduces the risk of environmental pollution from pesticide residues. All drainings should be collected and disposed of in an approved manner.
2) Dead livestock deposited in the waste disposal area should be burried within 24 hours of deposit with a minimum of 1 metre of earthen cover.
3) All bulky metals should be stored in a separate, above grade compound away from the active disposal area.
4) Refer to Manitoba Regulation 208/76 under the Clean Environment Act for further clarification of these recommendations and other waste disposal ground operating procedures.

APPENDIX A

Date: August 23, 1983 Location: Shellmouth Waste Disposal Ground

Orientation: Taken from the site entrance looking north.

Comments: Note only about 1/3 of the total cleared area is used for active waste disposal.

Date: August 23, 1983 Location: Shellmouth Waste Disposal Ground

Orientation: Taken from the north end of the disposal trench looking south.

Comments: Pesticide cans and bulk metals are not separated from the active area. No cover material was available on site.

APPENDIX B

FILE No. 5.7.4.2.

WATER RESOURCES BRANCH

GROUNDWATER POLLUTION HAZARD APPRAISAL

POTENTIAL SOURCE OF POLLUTION	Waste Disposal Ground
LOCATION OF SOURCE	SW33-22-29W
OWNER OF SOURCE	R.M. of Shellmouth, Shellmouth

GEOLOGICAL CONDITIONS	SURFICIAL DEPOSITS	From zero up to 30 m clay and till. In the flatter parts of the quarter section the clay is overlain by thin sand and gravel.
	BEDROCK	Shale, soft, clayey.

GROUNDWATER CONDITIONS	AQUIFERS	Some minor shallow aquifers may occur in the surface sand and gravel.
	WELLS	No wells reported on this quarter section. Shallow wells may exist at the base of the slope about 1 km west of here.

POLLUTION HAZARD

Because the surficial deposits and the bedrock consist mainly of impermeable or very low permeability materials, widespread aquifer pollution by leachates from the waste disposal ground is not likely.

COMMENTS

If the waste disposal ground is located in surface sand and gravel area,some very localized groundwater pollution may occur.

BY:
GROUNDWATER GEOLOGIST

M. Rutulis, P. Eng.

DATE: Dec. 7, 1983.

3.13

NINETTE WASTE DISPOSAL GROUND

E1/2-19-5-16W

R.M. OF STRATHCONA #4

3.13 Ninette Waste Disposal Ground

3.13.1 Location

The community of Ninette, Manitoba is located within the Rural Municipality of Strathcona, approximately 174 kilometres south-west of Winnipeg, along P.T.H. 23. The waste disposal area is located about 1.2 kilometres east of the community and the legal description of the site is E1/2-19-5-16W.

Figure A is a Rural Municipality Map locating the study area and the Community of Ninette within the Rural Municipality of Strathcona.

3.13.2 Physiography

This region is characterized by the steep valley walls of the Pembina River Valley and Pelican Lake, part of the Pembina River system. This particular disposal site is located at the base of the east valley wall just north of the Pelican Lake inlet. The land at the base of the valley is very flat with the exception of a railroad embankment on the north side of the disposal site which acts as as a containment barrier for the waste. North of this railway embankment the Pelican Lake inlet exsists as a swamp or marsh environment.

Surficial drainage for the area is down the valley wall to Pelican Lake. In the case of the disposal site drainage would be down the sides of the waste pile and down the embankment to the Pelican Lake inlet. Regional drainage for the region is south following the Pelican River water course.

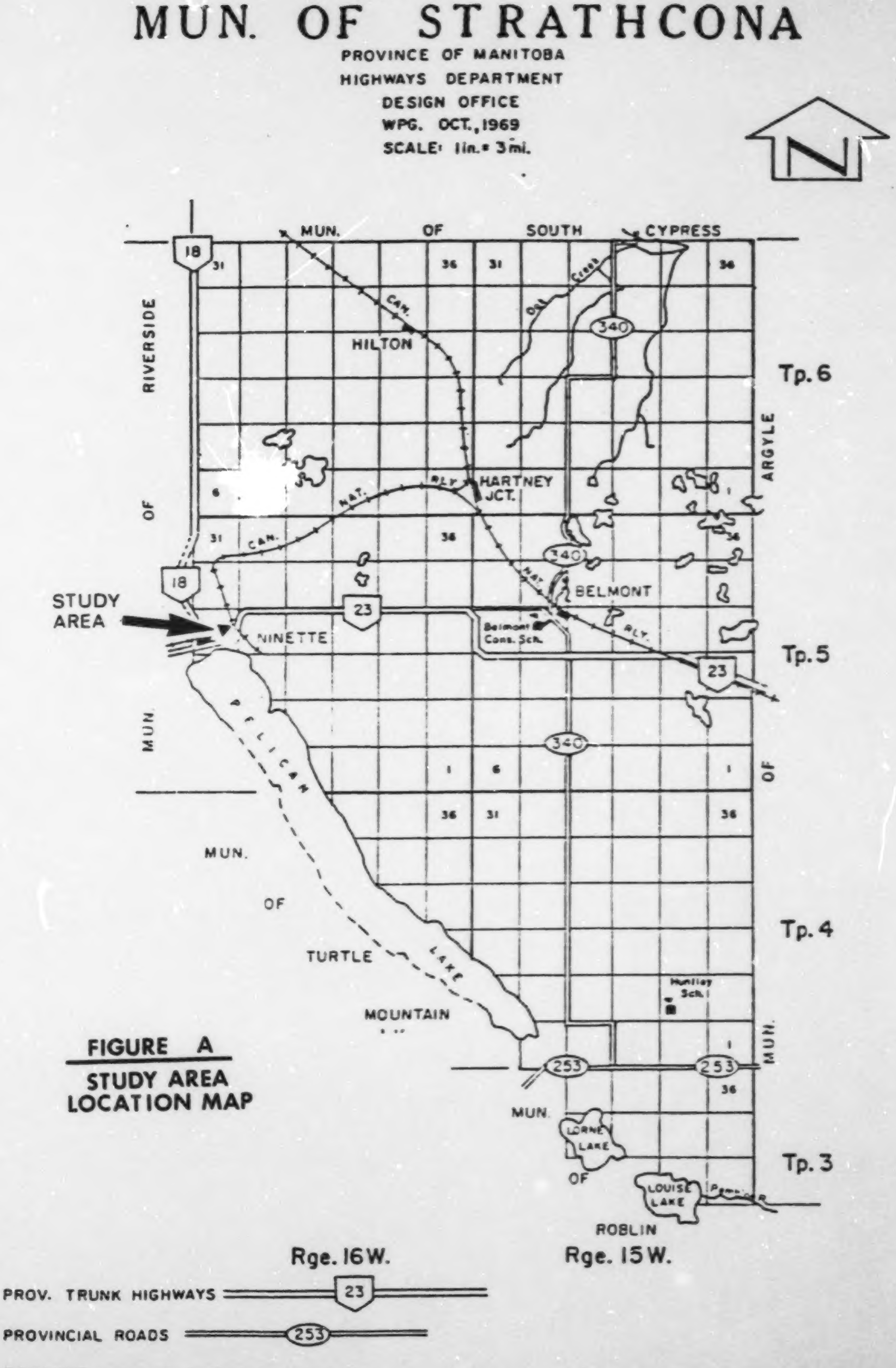

MUN. OF STRATHCONA
PROVINCE OF MANITOBA
HIGHWAYS DEPARTMENT
DESIGN OFFICE
WPG. OCT., 1969
SCALE: 1in.= 3mi.
N
MUN. OF SOUTH CYPRESS
18
31
36
31
36
CAN.
HILTON
340
Tp. 6
MUN. OF RIVERSIDE
ARGYLE
CAN. NAT. RLY
HARTNEY JCT.
6
1
31
36
36
340
18
BELMONT
STUDY AREA
23
NINETTE
Belmont Cons. Sch.
RLY.
23
Tp. 5
PELICAN
340
1
6
1
OF
36
31
36
MUN. OF TURTLE MOUNTAIN
LAKE
Tp. 4
Huntley Sch.
1
MUN.
253
253
36
MUN. OF ROBLIN
LORNE LAKE
LOUISE LAKE
Tp. 3
Rge. 16W.
Rge. 15W.
PROV. TRUNK HIGHWAYS
23
PROVINCIAL ROADS
253
RAILWAYS

FIGURE A

STUDY AREA LOCATION MAP

3.13.3 Site Conditions

During the site visit on August 16, 1983, a number of observations were made with regard to the Ninette waste disposal facility. Pictures taken during the site visit serve to illustrate the conditions in and around the inactive area of disposal. These pictures can be found in Appendix A, along with a detailed description of each view.

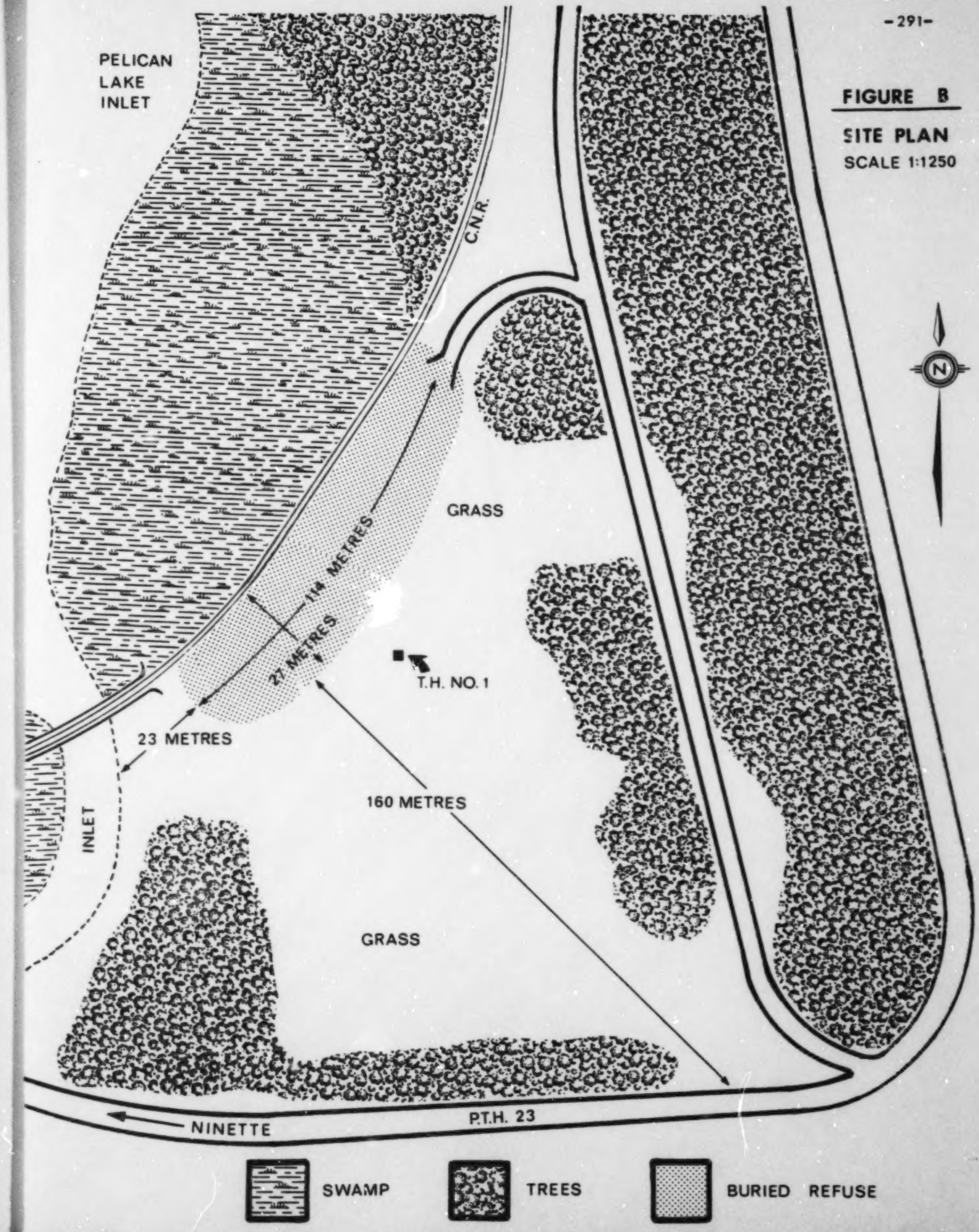
The disposal area covers an area of approximately 114 metres in length, (north-east to south-west) by 27.4 metres in width (north-west to south-east). Access to the area is by a gravel road located 1.5 kilometres east of Ninette running north of P.T.H. #23.

From the information gathered during phase one of this study and the initial site visit, it was learned that various municipal and domestic wastes were disposed of at this site. The Ninette Sanitorium located south of the disposal area was a prime user of the facility, depositing both hospital waste, leaves and grass from ground maintenance work. This waste disposal ground has been closed for at least 6 years and only leaves and grass cuttings are deposited there now. Surficial deposition and burial seems to have been the method of operation at this facility. All the waste has been compacted and covered with earth. Very little vegetation grows along the top of the disposal mound. The sides of the waste pile are fairly steep and the covered dump site reaches an elevation about 5.2 metres above grade. Figure B details the plan view of the site.

FIGURE B

SITE PLAN

SCALE 1:1250


PELICAN LAKE INLET
C.N.R.
GRASS
114 METRES
27 METRES
T.H. NO. 1
23 METRES
160 METRES
INLET
GRASS
NINETTE
P.T.H. 23
N
SWAMP
TREES
BURIED REFUSE

3.13.4 Surficial Geology and Hydrogeology

In general the surficial geology around the Ninette waste disposal ground can be directly related to a non glacial environment. Glacial till material 1 to 30 metres thick, made up of sand, silt, clay and gravel is common. These alluvial sediments have been deposited in what can be described as a glacial spillway, which has now become the Pembina River Valley.

The bedrock in the area is commonly shale. This shale contains fracture zones which may contain water and form aquifers. Sand and gravel interbedded in the alluvial sediments form the most common aquifers in this region. There is only one well known to be in the vicinity of the waste disposal area. This well is located at the Ninette Sanitorium and is fairly deep, probably due to the shale fracture zone.

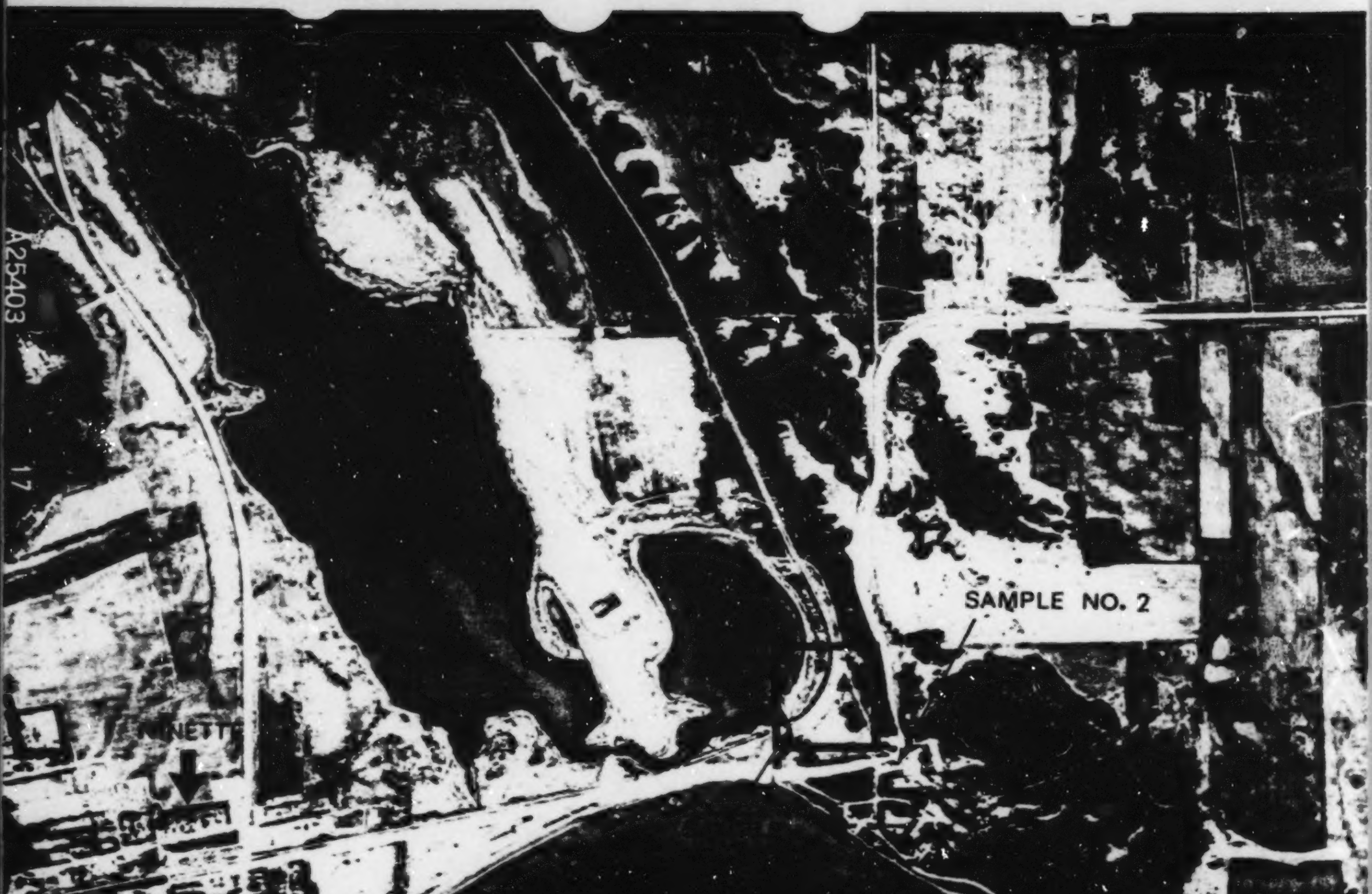
The Water Resources Branch, Department of Natural Resources, Province of Manitoba was requested to complete a groundwater pollution hazard appraisal for the inactive Ninette waste disposal facility. A copy of this appraisal can be found in Appendix B. Basically the comments made on this appraisal agree with the above general geology. This disposal site is located in an area designated as a groundwater pollution hazard area because of the interbedded sand and gravel deposits that are expected to be at or near the surface in the area around the waste disposal site. A field investigation including test drilling and possible monitoring well installation was indicated in order to confirm subsurface conditions.

On November 9, 1983, one 12 metre deep test hole was drilled near the inactive Ninette waste disposal ground using the mud rotary drilling method. Because no significant surficial sand, gravel or shale deposits were encountered, a monitoring well was not installed at this drill site. A geologic log for the test hole drilled can be found in Appendix C. Soil samples taken during the test drilling program have been retained for future reference. The test hole location can be found on Figure B.

3.13.5 Groundwater Sampling

On November 9, 1983 a surface water sample was obtained from the Pelican Lake inlet 23 metres west of the disposal site. On January 10. 1984, a groundwater sample was obtained from a well located approximately 200 metres south-east of the disposal site, at the Ninette Sanitorium. The water from this well is only used for lawn maintenance services. These samples were submitted to the W. M. Ward Technical Services Laboratory for analysis. Bacteriological samples were submitted to the Cadham Provincial Laboratory for testing. The results of these analyses can be found in Appendix D.

Figure C is an air photo of the study area at a scale of 1:15840. This photo shows the location of the disposal site with respect to the Town of Ninette. The groundwater and surface water sampling points established during the field investigation of this waste disposal site have been located on this air photo.


A25403
17
NNETTE
SAMPLE NO. 2

3.13.6 Analytical Results and Conclusions

With regard to the inactive Ninette waste disposal facility and the phase two assessment of the site, there is no observed effect on the surrounding environment. Data collected throughout the study shows no hazard to the public health which can be directly attributed to the waste disposal ground.

Groundwater

Because the disposal site was considered to be in a groundwater pollution hazard area, a test drilling program was established to identify the surficial geologic and hydrogeologic conditions in and around the site. The surficial deposits at this particular site are made up of a high percentage of brown silt and clay with small to medium sized shale pieces intermixed. After the first 6 metres the shattered shale content increases to about 50 percent.

Surficial deposition and burial of the waste, as in this case, has left the upper low permeability materials relatively intact. This means that approximately 6 metres of alluvial material containing a large percentage of clay and silt underlies this particular waste facility. This clay and silt acts to contain downward leachate migration. Any contamination reaching the groundwater table would be confined to the area east of Pelican Lake. There are no groundwater supplies taken from the area east of the lake that are used for public consumption. The water quality analysis conducted on the well at the Ninette Sanitorium was compared to the "Guidelines for Canadian Drinking Water Quality" prepared by Health and Welfare Canada in 1978. This groundwater supply can be described in general as good quality for domestic purposes.

The test drilling observations and laboratory results indicate that groundwater contamination is not a problem with respect to the inactive Ninette waste disposal facility.

Methane

Methane gas produced through the decomposition of buried domestic waste can be of concern to buildings located in close proximity to waste disposal sites. In this case, however, because of the surficial soil conditions, a disposal method practicing above ground deposition and the distance to the Sanitorium 200 metres south-east of the site, methane production, if any, is not of concern.

It should be noted that explosimeter tests for methane gas were conducted during the test drilling program and no positive readings were recorded.

Surface Water

Surface water pollution from contaminated groundwater migration to the Pelican Lake inlet is not of concern because of the highly impermeable nature of the surficial sediments underlying the inactive waste disposal area. These sediments act to contain downward leachate migration.

Contamination of the inlet and surrounding swampland from surface runoff may be of concern. This site is located only 23 metres east of the Pelican Lake inlet channel. The land slopes toward the inlet and surficial runoff from rain water and melt water passing over or around the waste disposal ground could easily reach the water course. Fairly good cover of the waste at this site has been provided. The sides of the waste pile are steep and precipitation water would run off these slopes fairly readily without contacting the buried waste. The top surface of the refuse pile is flat, allowing the collection of rainwater and the possible percollation of this water through the waste creating leachate, which could travel the 23 metres down the slope to the Pelican Lake inlet. Laboratory results from the water sample obtained from the inlet downstream from the disposal site indicates no contamination which can be attributed to the waste disposal facility. Further monitoring of the inlet water on a regular basis would be required in order to prove any such contamination from surficial leachate runoff.

3.13.7 Recommendations

1) Construction taking place on or near the railway bridge over the Pelican Lake inlet may disturb the waste pile, any exposed waste should be re-covered.

2) A cover of low permeability earthen material compacted to a thickness of .6 metres should be applied to the top flat surface of the disposal area and contoured in such a way as to allow rain water and melt water to run off the site.

3) Refer to Manitoba Regulation 208/76 under the Clean Environment Act for further clarification of these recommendations and other waste disposal ground operating procedures.

APPENDIX A

Date: August 16, 1983 Location: Ninette Waste Disposal Ground

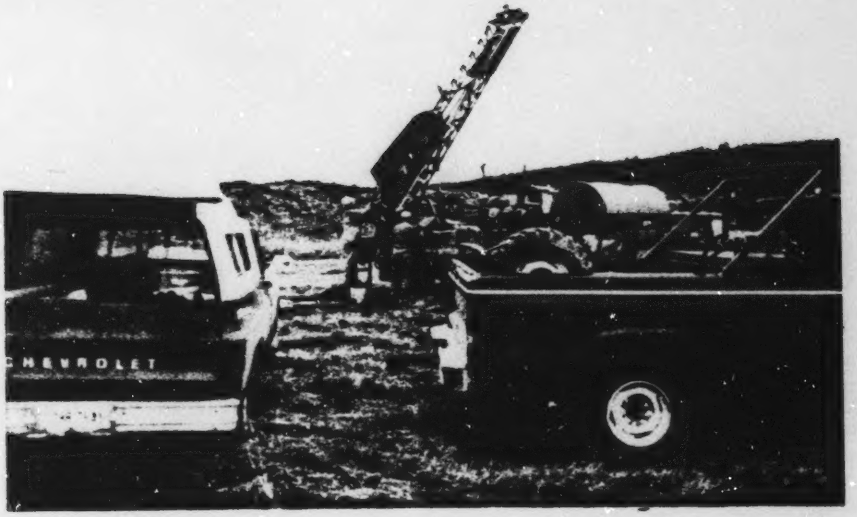
Orientation: Taken from south-east of the site looking north-west.

Comments: This view of the disposal site shows the hight of the mound above grade. The south-east edge of this mound is still used for disposing of grass cuttings and leaves.

Date: August 16, 1983 Location: Ninette Waste Disposal Ground

Orientation: Taken from the top of the disposal mound looking south-west.

Comments: Note the Pelican lake inlet in the center of this photograph. The railway tracks act as a containment wall for the waste pile.



Date: August 16, 1983 Location: Ninette Waste Disposal Ground

Orientation: Taken from south-east of the site looking north-west.

Comments: Drilling of test hole #1.

APPENDIX B

FILE NO. 5.7.4.2.

WATER RESOURCES BRANCH

GROUNDWATER POLLUTION HAZARD APPRAISAL

POTENTIAL SOURCE OF POLLUTION	Waste Disposal Ground
LOCATION OF SOURCE	E½-19-5-16W
OWNER OF SOURCE	R.M. of Strathcona, Ninette

GEOLOGICAL CONDITIONS	SURFICIAL DEPOSITS	Lower part of ½-section (valley bottom): interbedded clay, silt, sand and gravel (alluvium). Upper part of half-section (side and edge of valley): shale with thin covering of till.
	BEDROCK	Shale.

GROUNDWATER CONDITIONS	AQUIFERS	The sand and gravel of the alluvial deposits constitutes the most common aquifers in the area. The shale contains fractured zones, which may form aquifers in the lower part of the section.
	WELLS	No wells reported on this section (test holes only).

POLLUTION HAZARD

Because some of the alluvial sand and gravel aquifers are at or near ground surface, infiltration of leachates into aquifers is possible in the lower part of the half-section. As in the upper part shallow aquifers do not exist, groundwater pollution there is not likely.

COMMENTS

Since groundwater flow in the half-section likely is toward the lake and marsh that occupies much of the section, if groundwater pollution were to occur, it would not spread outside the half-section.

BY: M. Rutulis, P. Eng.
GROUNDWATER GEOLOGIST

DATE: Dec. 7, 1983

APPENDIX C

GEOLOGIC LOG

Test Hole Identification: Ninette, T.H. #1

Location: Ninette, Manitoba. R.M. of Strathcona.

Legal Description: E½-19-5-16W

Date: November 9, 1983.

Time: 9:00 A.M. to 10:00 A.M.

Total Depth: 12 Metres

Type Of Casing: N/A

Type Of Screen: N/A

Depth	Description
0 to 1.5 m.	Brown clay, some very fine grained shale.
1.5 to 4.6 m.	Brown clay, some medium sized shale pieces.
4.6 to 6.1 m.	Tight brown clay, a few large shale pieces.
6.1 to 7.6 m.	Brown grading to gray clay. 50% medium shale.
7.6 to 10.6 m.	Gray shale and clay, about 80% clay.
10.6 to 12 m.	Gray shale and clay, About 75% clay, shale pieces medium sized.

APPENDIX D

Water Quality Analysis

Project: Phase II, Landfill Study

Location: Ninette, R.M. of Strathcona, E½-19-5-16W

Sample #: 1

Date: Result A; November 9. 1983 Result B; N/A

Parameter	Result A	Result B	Measured Unit
Conductivity	1610.00	-	umho/cm
Residue Total	1360.00	-	mg/l
Residue Filterable	1230.00	-	mg/l
Residue Non Filterable	125.00	-	mg/l
pH	8.45	-	units
Alkalinity Total (CaCO3)	418.00	-	mg/l
Alkalinity (HCO3)	495.00	-	mg/l
Alkalinity (CO3)	7.20	-	mg/l
Alkalinity (OH)	0.00	-	mg/l
Arsenic, As	0.001	-	mg/l
Cadmium, Cd	L 0.001	-	mg/l
Copper, Cu	0.06	-	mg/l
Lead, Pb	L 0.005	-	mg/l
Zinc, Zn	0.06	-	mg/l
Chromium, Cr	L 0.005	-	mg/l
Calcium, Ca	69.30	-	mg/l
Magnesium, Mg	91.90	-	mg/l
Hardness (CaCO3)	552.00	-	mg/l
Manganese, Mn	0.37	-	mg/l
Iron, Fe	0.35	-	mg/l
Sodium, Na	220.00	-	mg/l
Color	50.00	-	units
Turbidity	20.00	-	NTU
Cyanide, CN	L 0.02	-	mg/l
NO3-NO2-N	0.08	-	mg/l
Chloride, Cl	77.00	-	mg/l
Sulphate, SO4	350.00	-	mg/l
Coliform Group	-	-	per 100 ml
Fecal Coliform	-	-	per 100 ml

L = Less Than

G = Greater Than

Water Quality Analysis

Project: Phase II, Landfill Study.

Location: Ninette, R.M. of Strathcona. E½-19-5-16W

Sample #: 2

Date: Result A; N/A Result B; January 11, 1984

Parameter	Result A	Result B	Measured Unit
Conductivity	-	1320.00	umho/cm
Residue Total	-	-	mg/l
Residue Filterable	-	850.00	mg/l
Residue Non Filterable	-	-	mg/l
pH	-	7.60	units
Alkalinity Total (CaCO3)	-	290.00	mg/l
Alkalinity (HCO3)	-	354.00	mg/l
Alkalinity (CO3)	-	0.00	mg/l
Alkalinity (OH)	-	0.00	mg/l
Arsenic, As	-	L 0.001	mg/l
Cadmium, Cd	-	L 0.001	mg/l
Copper, Cu	-	0.02	mg/l
Lead, Pb	-	L 0.005	mg/l
Zinc, Zn	-	0.10	mg/l
Chromium, Cr	-	L 0.005	mg/l
Calcium, Ca	-	69.10	mg/l
Magnesium, Mg	-	28.60	mg/l
Hardness (CaCO3)	-	290.00	mg/l
Manganese, Mn	-	0.02	mg/l
Iron, Fe	-	0.57	mg/l
Sodium, Na	-	167.00	mg/l
Color	-	-	units
Turbidity	-	-	NTU
Cyanide, CN	-	-	mg/l
NO3-NO2-N	-	0.01	mg/l
Chloride, Cl	-	146.00	mg/l
Sulphate, SO4	-	170.00	mg/l
Coliform Group	-	L 1.00	per 100 ml
Fecal Coliform	-	L 1.00	per 100 ml

L = Less Than

G = Greater Than

3.14

SWAN RIVER WASTE DISPOSAL GROUND

NW-15-36-27W

R.M. OF SWAN RIVER

3.14 Swan River Waste Disposal Ground

3.14.1 Location

The Town of Swan River, Manitoba is located within the Rural Municipality of Swan River, approximately 368 kilometres north-west of Winnipeg along P.T.H. 10. The waste disposal area is located about .8 kilometres south-east of the town and the legal description of the site is NW-15-36-27W.

Figure A is a Rural Municipality Map locating the study area and the Town of Swan River within the Rural Municipality of Swan River.

3.14.2 Physiography

This area is characterized by beach and nearshore sedimentary deposits forming distinct ridges on an otherwise flat terrain. These sediments are deposited in a pro-glacial or glacial environment and generally reflect the form of the underlying bedrock topography. In the area of the Swan River waste disposal ground relief is restricted to the Tamarack Creek Channel which runs south to north between the old and new waste disposal facilities.

Approximately 878 metres south-west of the disposal area lies the Roaring River and approximately 1.8 kilometres north of the site lies the Swan River Channel. Both the Roaring River and Tamarack Creek flow north-east and join the Swan River. Surficial drainage in and around the Swan River disposal grounds is to Tamarack Creek. Regional drainage for the area is north-east as part of the Swan River Drainage Basin.

Nº 103

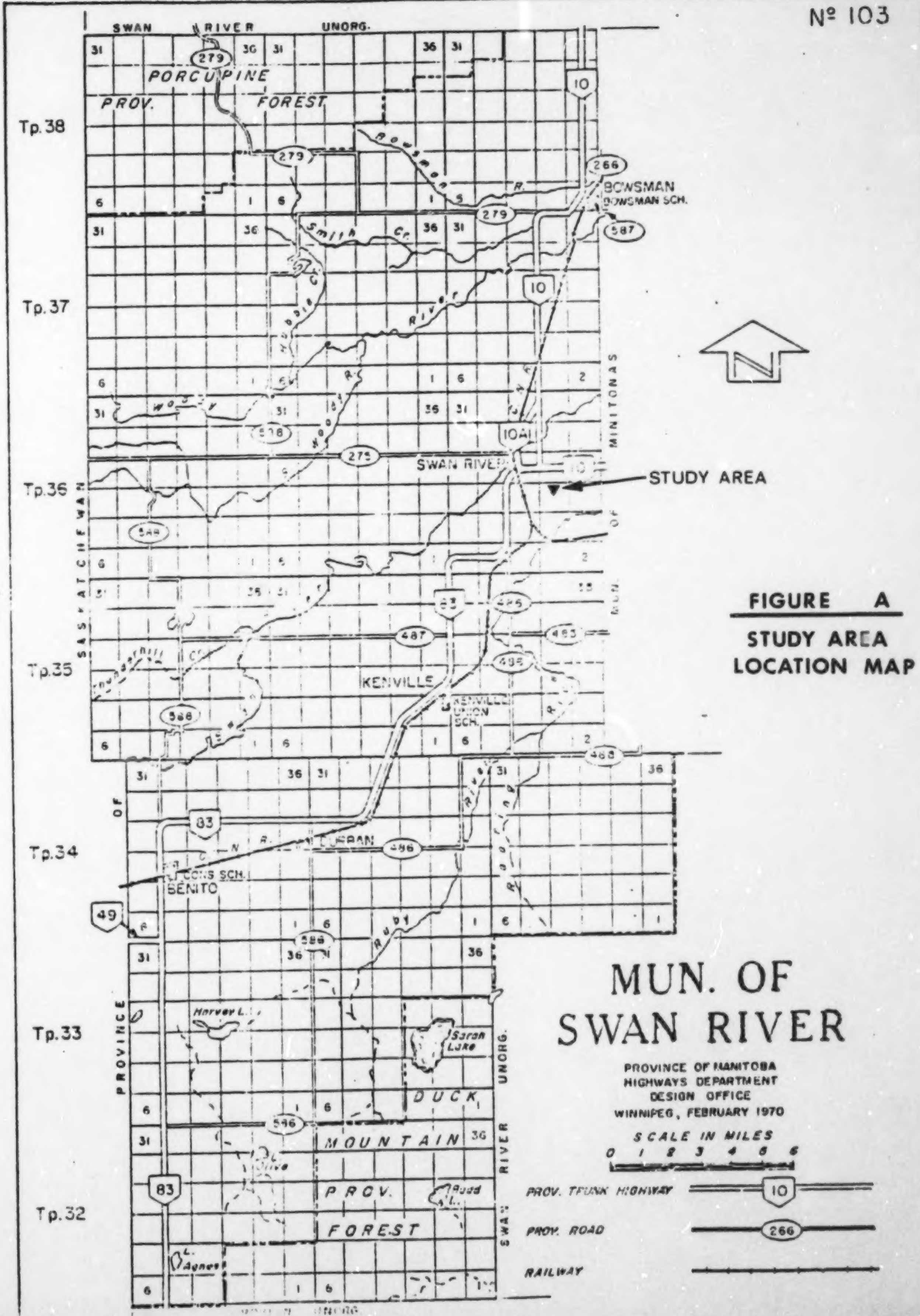

SWAN RIVER UNORG.
PORCUPINE PROV. FOREST
Tp. 38
Tp. 37
Tp. 36
Tp. 35
Tp. 34
Tp. 33
Tp. 32
Bowsman R.
Smith Cr.
Swan River
Woody R.
BOWSMAN
BOWSMAN SCH.
SWAN RIVER
KENVILLE
KENVILLE UNION SCH.
DURBAN
BENITO
CONS. SCH.
C. N. R.
SASKATCHEWAN
PROVINCE OF
MUN. OF MINITONAS
STUDY AREA
Harvey L.
Sarah Lake
DUCK MOUNTAIN PROV. FOREST
L. Agnes
Ruby R.
SWAN RIVER UNORG.
279
266
587
10
10A
83
49
486
487
488
588
586
588

FIGURE A

STUDY AREA LOCATION MAP

MUN. OF SWAN RIVER

PROVINCE OF MANITOBA
HIGHWAYS DEPARTMENT
DESIGN OFFICE
WINNIPEG, FEBRUARY 1970

SCALE IN MILES
0 1 2 3 4 5 6
PROV. TRUNK HIGHWAY 10
PROV. ROAD 266
RAILWAY

3.14.3 Site Conditions

During the site visit on August 23, 1983, a number of observations were made with regard to the Swan River waste disposal facility. Pictures taken during the site visit serve to illustrate the conditions in and around the active and inactive areas of disposal. These pictures can be found in Appendix A along with a detailed description of each view.

The Swan River disposal facility is made up of two sites. The inactive site initially designated for this phase II assessment is located at NW-15-36-27W and a second active area located at NE-15-36-27W is approximately 190 metres east of the inactive area. Through discussion with the project steering committee it was decided to investigate both of these sites for the purpose of this phase II evaluation.

Area #1

This area has been closed to waste burial for at least 6 years. Its legal description is NW-15-36-27W and lies just west of Tamarack Creek. The inactive disposal site covers an area of approximately 182 metres in length, (east to west) by 97 metres in width, (north to south). The method of operation at this site was trench and fill. The disposal trench has been covered and compacted and piles of ungraded fill material are in evidence on the west side of the area. Surficial disposal of some waste such as bulky metals, pesticide cans and waste tires continues adjacent to the gravel road on the south side of the site. A 1.2 metre high, wire fence separates the tires disposal area and the bulk metals disposal area from the rest of the inactive waste disposal ground. The waste disposal access road runs east off a mile road 1.6 kilometres south of the F.T.H. 10, Hwy. 10A junction in Swan River. A sign at the west end of the access road indicates the hours of operation at this particular disposal facility. Signs designating "metals only" and "chemical containers in designated area only" are in evidence around the surficial disposal area.

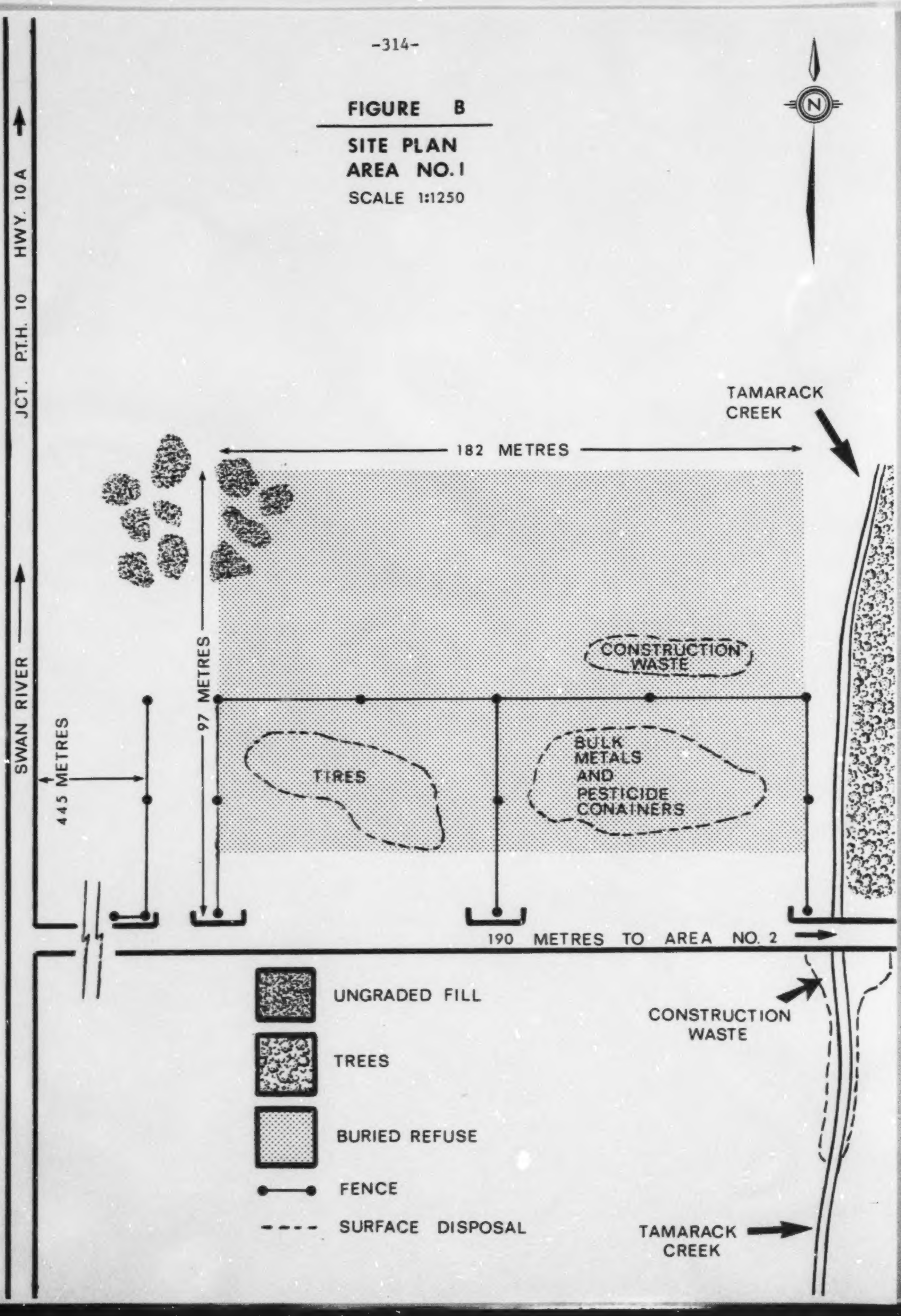
Pesticide containers are mixed with the rest of the bulky metal waste. The stockpile of tires have been burned on site since the initial site visit. Construction materials and other non-metal bulk wastes have been dumped at surface behind the bulk metals collection area. Wood, cement, brick and tree logs have been deposited along the Tamarack Creek Channel south of the disposal grounds. There have been some complaints by a local resident about this creek disposal. Surficial disposal of sewage or septic sludge is evident between the piles of ungraded fill material on the west side of the inactive disposal area. Figure B details the planned view of Area #1.

Area #2

This disposal area contains two waste burial trenches. The west trench has been filled and covered, the other is the active Swan River waste disposal site. The legal discription of this site is NE-15-36-27W. This disposal area is located 190 metres east of area #1 on the east side of Tamarack Creek. This disposal facility covers an area of approximately 213 metres in length, (east to west) by 122 metres in width, (north to south). A 3 metre high, wire fence

FIGURE B

SITE PLAN
AREA NO. 1
SCALE 1:1250


N
JCT. P.T.H. 10 HWY. 10 A
SWAN RIVER
445 METRES
97 METRES
182 METRES
TAMARACK CREEK
CONSTRUCTION WASTE
TIRES
BULK METALS AND PESTICIDE CONAINERS
190 METRES TO AREA NO. 2
CONSTRUCTION WASTE
TAMARACK CREEK
UNGRADED FILL
TREES
BURIED REFUSE
FENCE
SURFACE DISPOSAL

encloses this area on the south, east and 1/2 of the north side. The west 1/2 of the north perimeter and the west side is enclosed by trees. There is no gate across the access road. Access to this area is by an eastern extention of the area #1 access road. Signs at this site indicate "dry garbage only", "no carcasses" and "no shooting". There is a small shack just inside the entrance to the active area.

The active disposal area is a pit 91 metres long by 36.5 metres wide and approximately 3 metres in depth. From information collected during phase I of this study and while conducting the site inspection, it was learned that many varieties of domestic and municipal waste are deposited within the active area of disposal.

While making the site evaluation it was observed that dumping is practiced on all sides of the active disposal pit. Uncontrolled burning continues all around the active area. Bulk metal waste and some pesticide containers were in evidence in the active area. Approximately .6 metres to .9 metres of water is contained in the bottom of the disposal trench. Gulls and ravens were present scavenging the active area. Figure C details the plan view of area #2.

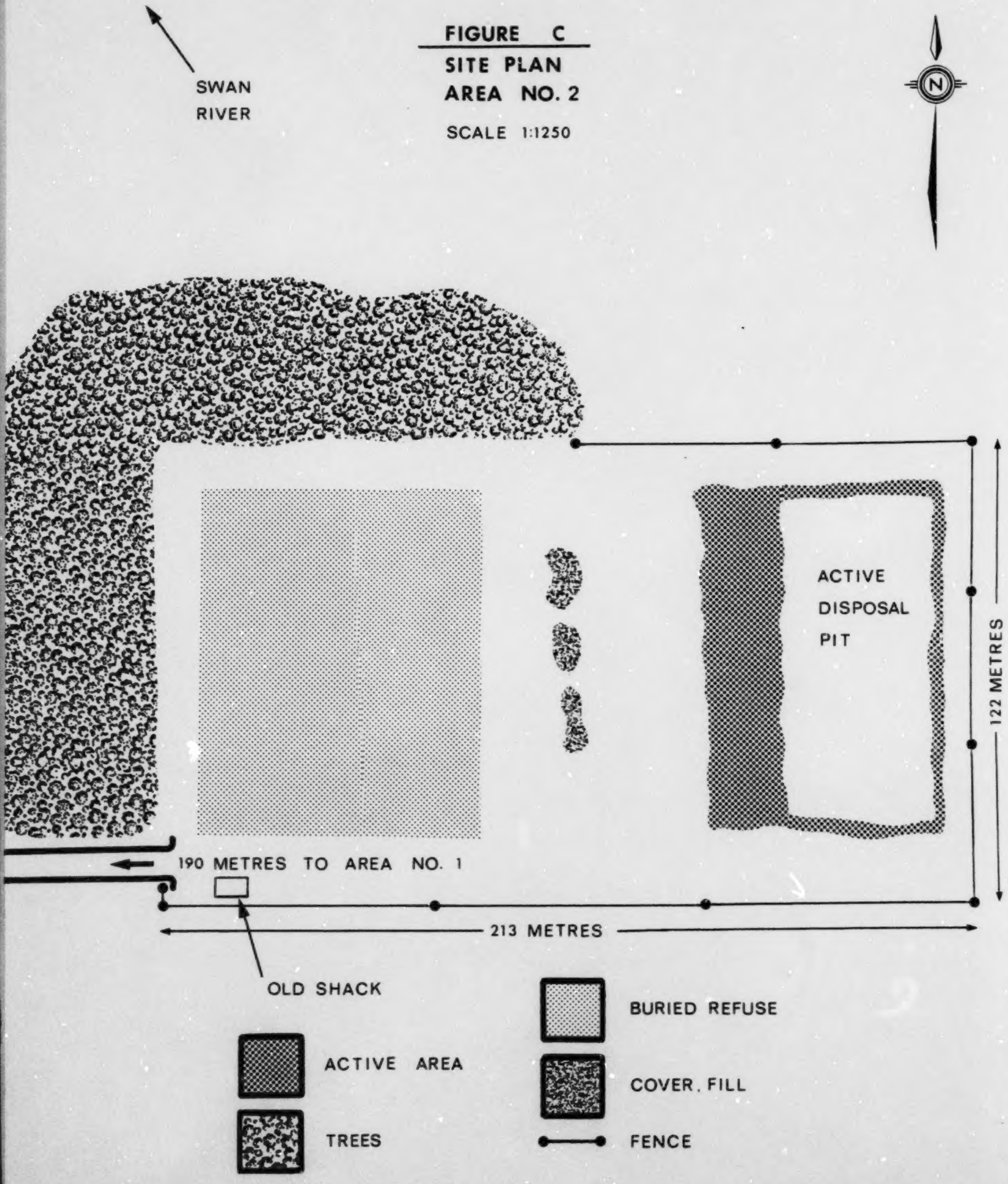
3.14.4 Surficial Geology and Hydrogeology

In general the surficial geology around the Swan River area can be directly related to a Pro-glacial or Glacial environment. One to 50 metres of clay, silt, sand and gravel deposited in pro-glacial lakes is the common sedimentation for this area. This material is

FIGURE C

SITE PLAN
AREA NO. 2

SCALE 1:1250


SWAN
RIVER
N
ACTIVE
DISPOSAL
PIT
122 METRES
190 METRES TO AREA NO. 1
213 METRES
OLD SHACK
BURIED REFUSE
ACTIVE AREA
COVER. FILL
TREES
FENCE

predominantly beach or nearshore deposits but may include some areas of wave washed till and exposed bedrock. In the subsurface around the Swan River waste disposal ground up to 8 metres of sand overlies the silt and clay layered till.

The bedrock in the area is made up of shale and sandstone beds. The sandstone beds are the most common source of groundwater in this region. Some domestic groundwater supplies have been drawn from the surficial water bearing sand and gravel deposits.

The Water Resources Branch, Department of Natural Resources, Province of Manitoba, was requested to complete a groundwater pollution hazard appraisal for the Swan River waste disposal facility. A copy of this appraisal can be found in Appendix B. Basically the comments made on the appraisal agree with the above general geology. The Swan River waste disposal ground is located in an area designated as a groundwater pollution hazard area with respect to the surficial water bearing sands and gravels. The sandstone aquifer would not be affected by leachates from the waste disposal ground. Because of the groundwater pollution hazard a field investigation including test drilling and monitoring well installation to confirm subsurface geological and hydrogeological conditions was formulated for the study area.

Through discussion with the steering committee it was decided that because of the difficulty and cost of transporting the required drilling equipment to Swan River and the budget within which this project had to operate, the subsurface part of the field investigation would be postponed until such time as the work became practical.

3.14.5 Groundwater Sampling

On November 12, 1983 and again on January 12, 1984, groundwater samples were collected from three residences in close proximity to the Swan River waste disposal grounds. From Tamarack Creek a surface water sample was collected during the November 12, 1983 site visit. These samples were submitted to the W. M. Ward Tecnical services Laboratory for analysis. Bacteriological samples were submitted to the Cadham Provincial Laboratory for testing. The results of these analyses can be found in Appendix C.

Figure D is an air photo of the study area at a scale of 1:15840. This photo shows the location of the disposal sites with respect to the Town of Swan River. The groundwater sampling points established during the field investigation of this waste disposal facility have been located on this air photo.

3.14.6 Analytical Results and Conclusions

With regard to the Swan River waste facility and the phase two assessment of the site, some localized environmental damage has already been caused by the disposal of bulk construction wastes such as wood and cement in the Tamarack Creek Channel south of the waste disposal grounds access road. Contamination of the underlying surficial sand and gravel aquifer is also suspected but unproven at this time. Contamination of Tamarack Creek by groundwater leachate migration or surface runoff may be a concern but is also unproven at this time.

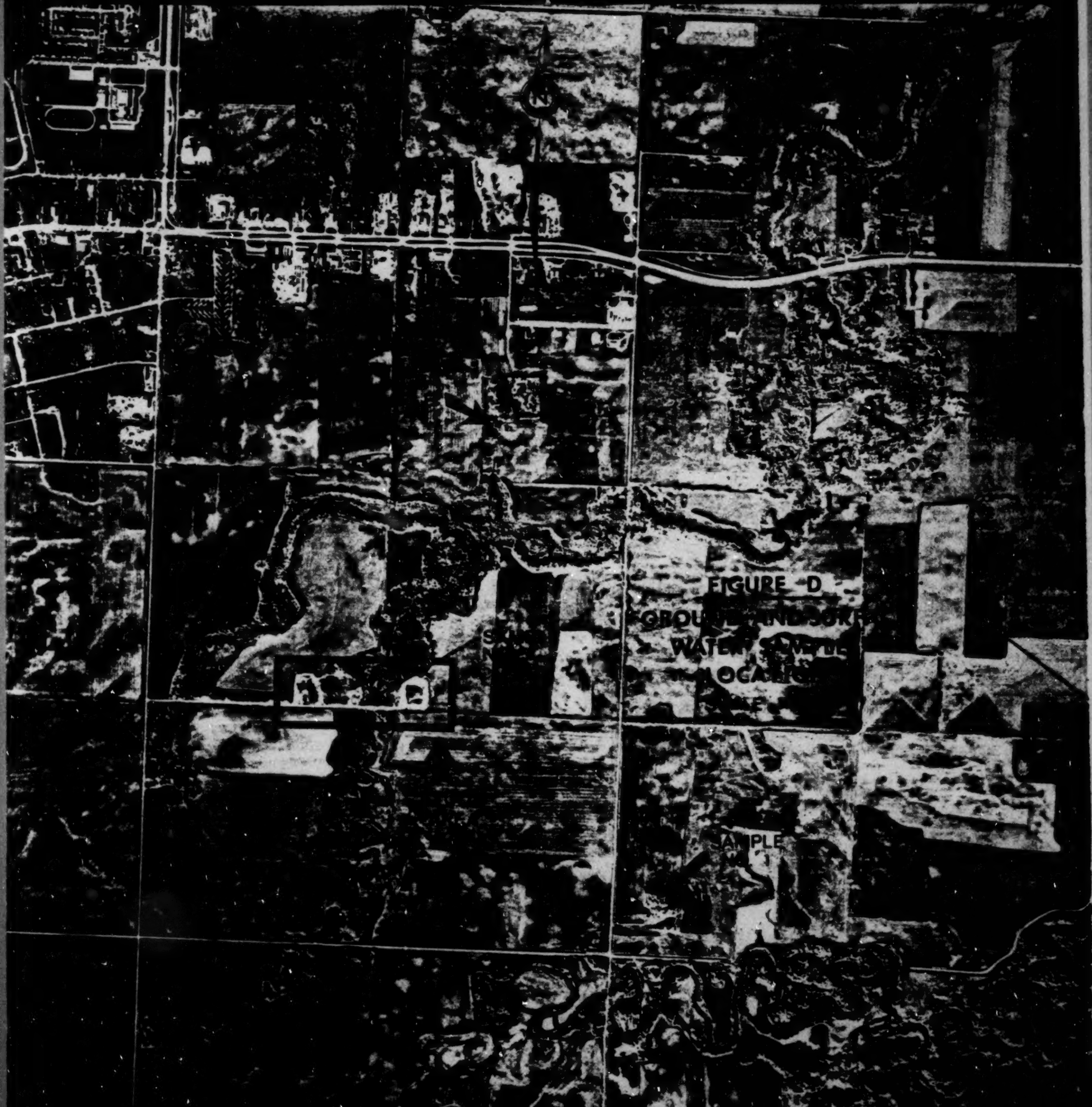


FIGURE D
GROUND AND SURF
WATER SAMPLE
LOCATION
AMPLE
1

Data collected to date shows no hazard to the public health which can be directly attributed to the Swan River waste disposal grounds.

Groundwater

Because the site is considered to be in a groundwater pollution hazard area a test drilling and monitoring well installation program should be undertaken to confirm subsurface geologic and hydrogeologic conditions. Regional groundwater flow would be in a north-easterly direction towards the Swan River. Intersection of the groundwater table is suspected in the active disposal pit because of the amount of water contained in the bottom of the trench. If this is the case, it is expected that both the inactive site (area #1) and the covered and compacted pit in the active area (area #2) have intersected the water table and direct contact between the waste and the groundwater is likely. Leachates in this case have direct access to the surficial groundwater aquifer and can move freely in a north-easterly direction with the regional groundwater flow. This becomes a concern with respect to any local domestic groundwater supplies drawn from the surficial sands and gravels.

Test drilling to confirm subsurface conditions and monitoring well installation to observe groundwater quality is required before further conclusions can be drawn with respect to the geologic and hydrogeologic characteristics of the area.

Water quality analyses conducted on three local domestic groundwater supplies were compared to the "Guidelines for Canadian

Drinking Water Quality" prepared by Health and Welfare Canada in 1978. Sample #1 and #4 both domestic groundwater supplies can be described in general as good quality for public consumption.

Results from sample #2, the third domestic groundwater supply, located north-east of the disposal area, indicated not only a higher than acceptable level of nitrates, but significant differences in a number of other parametres when compared to the other groundwater samples collected from this area. This problem may be the results of some localized source of pollution. It is felt that further sampling of the already established groundwater monitoring points (samples #1, #2, #4) and the establishment of a test drilling and monitoring well installation program is warranted to confirm the groundwater conditions in and around the Swan River waste disposal grounds.

Methane

Methane gas produced through the decomposition of buried domestic waste can be of concern to buildings located in close proximity to waste disposal sites. In this case, however, because of the distance to the nearest building, about 426 metres south-west of the site, methane gas production, if any, would not be of concern.

Surface Water

Surface water pollution has already occurred with the disposal of bulky waste construction materials in the Tamarack Creek Channel south of the waste disposal ground access road. Because both the inactive (area #1) and active (area #2) sites are in close proximity to the creek, contamination of this surface water is possible. Contamination by groundwater migration to the surface water course could be a concern if the surficial sand and gravel aquifer is hydraulically connected to the creek. More extensive test drilling and groundwater flow testing would be required to prove the hydraulic connection.

Laboratory results from the water sample obtained from the creek (sample #3) indicate no contamination which can be attributed to the waste facility. Surficial runoff from the disposal sites to Tamarack Creek is not of concern because the trench and fill method of operation eliminates the possibility of water contacting the waste above grade.

3.14.7 Recommendations

1) All pesticide containers should be drained, crushed and stored in a separate area away from the active disposal trench. Crushing the containers reduces the size of storage area required to hold the empty cans. Draining the cans reduces the risk of environmental pollution from pesticide residues. All drainings should be collected and disposed of in an approved manner.
2) All bulky metals should be stored in a separate above grade compound away from the active area.
3) The disposal of sewage waste and septic sludge at the inactive Swan River disposal site, (area #1) should be discontinued. This type of disposal can be of environmental and health concern. Sewage and septic sludge should be disposed of in a separate facility constructed for that purpose within the active waste disposal ground (area #2) or at a suitably designed sewage treatment facility.

4) Further sampling of residences and monitoring wells to be installed during a test drilling program is warranted before further conclusions can be drawn.

5) If the data from the above recommended testing shows further environmental damage and concern for the public health, consideration should be given to locating a new facility in an area where groundwater and surface water contamination will not occur.

6) Burning of rubber tires is not permitted and this practice should be stopped. Rubber tires should be buried with the other conventional waste.

7) Disposal of waste in the Tamarack Creek Channel should be discontinued.

8) A cover of earthen material compacted to a thickness of .6 metres should be applied to the top flat surface of the inactive disposal area (area #1) and contoured in such a way as to allow rain water and melt water to run off the site. This also applies to the filled and covered waste trench in the active Swan River disposal area (area #2).

9) Refer to Manitoba Regulation 208/76 under the Clean Environment Act for further clarification of these recommendations and other waste disposal ground operating procedures.

APPENDIX A

SUMMER HOURS
MAY 1st TO OCTOBER 31st
MONDAY TO SATURDAY 8am TO 6pm
WINTER HOURS
NOVMBER 1st TO APRIL 30th
MONDAY TO FRIDAY 8am 5pm

Date: August 23, 1983 Location: Swan River Waste Disposal Ground

Orientation: Taken from the west end of the access road looking east.

Comments: This sign indicates the hours of operation at the Swan River waste disposal facility.

Date: August 23, 1983 Location: Swan River Waste Disposal Ground

Orientation: Taken from the site access road looking south.

Comments: Debris disposed of in the Tamarack Creek channel. These wastes are mostly construction type materials, waste wood, cement, and some trees and banches.

METALS
ONLY

Date: August 23, 1983 Location: Swan River Waste Disposal Ground

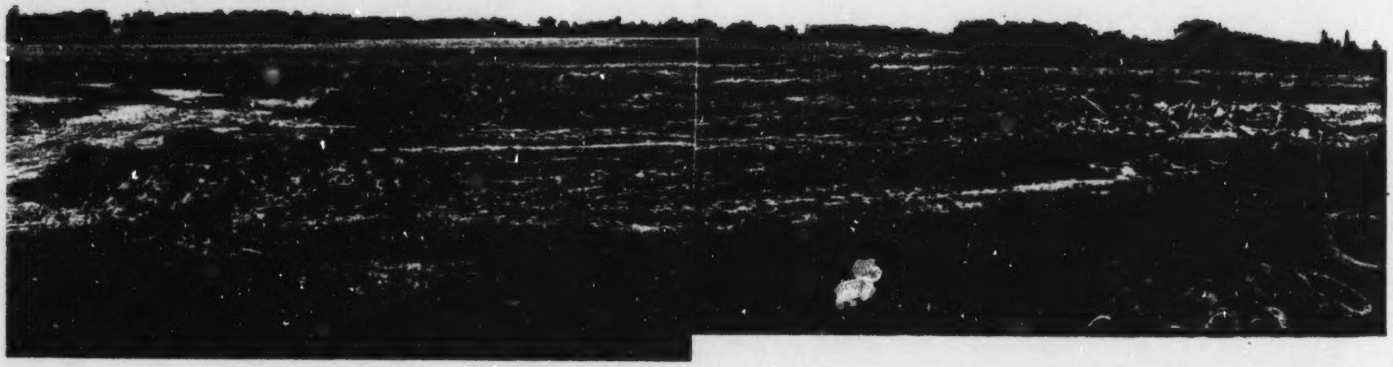
Orientation: Panorama, from left to right = looking from north-west to north-east.

Comments: This photograph shows the separated tires and bulk metals disposal areas. These areas are directly adjacent to the access road, and have been set up at the inactive Swan River Waste Disposal area.

Date: August 23, 1983 Location: Swan River Waste Disposal Ground

Orientation: Taken from the access road looking north.

Comments: This view of the bulk metals disposal area shows the large amount of pesticide cans deposited at this site.



Date: August 23, 1983 Location: Swan River Waste Disposal Ground

Orientation: Taken from the top of the waste tires pile looking north-east.

Comments: This view of the inactive Swan River disposal area shows that this site has been filled and compacted. Piles of cover material wait to be graded. Note the wet area in the center left of photo.

Date: August 23, 1983 Location: Swan River Waste Disposal Ground

Orientation: Taken from the center of the inactive site looking north-east.

Comments: Suspected sewage or septic sludge dumping at the inactive Swan River disposal site.

Date: August 23, 1983 Location: Swan River Waste Disposal Ground

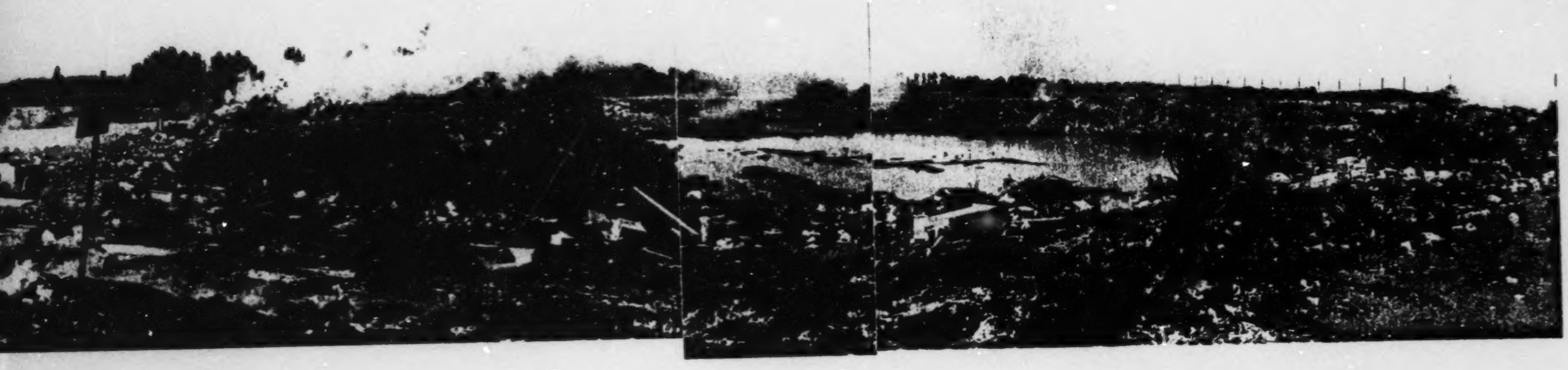
Orientation: Taken from the entrance to the active area looking east.

Comments: The active pit is in the background. One completed and filled trench is found in the center left of the photograph. Note burning is ongoing at this site.

Date: August 23, 1983 Location: Swan River Waste Disposal Ground

Orientation: Taken just inside the entrance to the active area looking north.

Comments: This view shows the covered and compacted trench located adjacent to the active disposal pit, on the west side.



Date: August 23, 1983 Location: Swan River Waste Disposal Ground

Orientation: Panorama, from left to right = looking from north-west to north-east.

Comments: Swan River waste disposal ground active trench. Some metals and pesticide cans can be found in the active area. Note the large amounts of water contained in the active pit.

APPENDIX B

FILE NO. 5.7.4.2.

WATER RESOURCES BRANCH

GROUNDWATER POLLUTION HAZARD APPRAISAL

POTENTIAL SOURCE OF POLLUTION	Waste Disposal Ground
LOCATION OF SOURCE	NW15-36-27W
OWNER OF SOURCE	R.M. of Swan River, Swan River.

GEOLOGICAL CONDITIONS	SURFICIAL DEPOSITS	Up to 8 m of sand and gravel underlain by glacial till and layers of clay and silt. The total thickness of the surficial deposits is about 50 m.
	BEDROCK	Shale and sandstone.

GROUNDWATER CONDITIONS	AQUIFERS	The sandstone beds constitute the most common aquifers in the area. The surface sand and gravel is also water bearing.
	WELLS	Most wells in the area draw water from the sandstone aquifers. A few shallow wells completed in the surface sand and gravel aquifers have been reported.

POLLUTION HAZARD

Because shallow surface sand and gravel aquifers exist in the area, groundwater pollution by leachates from the waste disposal ground is possible. The leachates are not likely to affect water quality in the sandstone aquifers.

COMMENTS

The potential pollution is not likely to have any effect on the municipal water supply.

BY: ____________ M. Rutulis, P. Eng. DATE: Dec. 7, 1983

GROUNDWATER GEOLOGIST

APPENDIX C

Water Quality Analysis

Project: Phase II Landfill study

Location: Swan River, R.M. of Swan River. SW-14-36-27W

Sample #: 1

Date: Result A; November 22, 1983 Result B; N/A

Parameter	Result A	Result B	Measured Unit
Conductivity	1180.00	-	umho/cm
Residue Total	890.00	-	mg/l
Residue Filterable	890.00	-	mg/l
Residue Non Filterable	L 5.00	-	mg/l
pH	7.40	-	units
Alkalinity Total (CaCO3)	352.00	-	mg/l
Alkalinity (HCO3)	429.00	-	mg/l
Alkalinity (CO3)	0.00	-	mg/l
Alkalinity (OH)	0.00	-	mg/l
Arsenic, As	L 0.001	-	mg/l
Cadmium, Cd	L 0.001	-	mg/l
Copper, Cu	L 0.01	-	mg/l
Lead, Pb	L 0.005	-	mg/l
Zinc, Zn	2.40	-	mg/l
Chromium, Cr	L 0.005	-	mg/l
Calcium, Ca	170.00	-	mg/l
Magnesium, Mg	51.20	-	mg/l
Hardness (CaCO3)	636.00	-	mg/l
Manganese, Mn	0.34	-	mg/l
Iron, Fe	0.52	-	mg/l
Sodium, Na	20.00	-	mg/l
Color	-	-	units
Turbidity	2.00	-	NTU
Cyanide, CN	L 0.02	-	mg/l
NO3-NO2-N	0.19	-	mg/l
Chloride, Cl	18.00	-	mg/l
Sulphate, SO4	300.00	-	mg/l
Coliform Group	L 1.00	-	per 100 ml
Fecal Coliform	-	-	per 100 ml

L = Less Than

G = Greater Than

Water Quality Analysis

Project: Phase II Landfill Study

Location: Swan River, R.M. of Swan River, SE-22-36-27W

Sample #: 2

Date: Result A; November 22, 1983 Result B; January 11, 1984

Parameter	Result A	Result B	Measured Unit
Conductivity	929.00	914.00	umho/cm
Residue Total	610.00	610.00	mg/l
Residue Filterable	610.00	610.00	mg/l
Residue Non Filterable	L 5.00	L 5.00	mg/l
pH	7.50	7.55	units
Alkalinity Total (CaCO3)	252.00	252.00	mg/l
Alkalinity (HCO3)	307.00	307.00	mg/l
Alkalinity (CO3)	0.00	0.00	mg/l
Alkalinity (OH)	0.00	0.00	mg/l
Arsenic, As	L 0.001	L 0.001	mg/l
Cadmium, Cd	L 0.001	L 0.001	mg/l
Copper, Cu	0.09	0.05	mg/l
Lead, Pb	0.006	L 0.005	mg/l
Zinc, Zn	0.58	0.84	mg/l
Chromium, Cr	L 0.005	L 0.005	mg/l
Calcium, Ca	110.00	110.00	mg/l
Magnesium, Mg	32.90	30.50	mg/l
Hardness (CaCO3)	410.00	400.00	mg/l
Manganese, Mn	0.08	0.06	mg/l
Iron, Fe	L 0.02	L 0.02	mg/l
Sodium, Na	32.00	30.00	mg/l
Color	-	-	units
Turbidity	0.55	0.25	NTU
Cyanide, CN	L 0.02	L 0.02	mg/l
NO3-NO2-N	38.00	37.00	mg/l
Chloride, Cl	28.00	22.00	mg/l
Sulphate, SO4	47.00	43.00	mg/l
Coliform Group	G 300.00	2.00	per 100 ml
Fecal Coliform	-	L 1.00	per 100 ml

L = Less Than

G = Greater Than

Water Quality Analysis

Project: Phase II Landfill Study

Location: Swan River, R.M. of Swan River. NW-15-36-27W

Sample #: 3

Date: Result A; November 22, 1983 Result B; N/A

Parameter	Result A	Result B	Measured Unit
Conductivity	832.00	-	umho/cm
Residue Total	640.00	-	mg/l
Residue Filterable	600.00	-	mg/l
Residue Non Filterable	38.00	-	mg/l
pH	7.95	-	units
Alkalinity Total (CaCO3)	436.00	-	mg/l
Alkalinity (HCO3)	532.00	-	mg/l
Alkalinity (CO3)	0.00	-	mg/l
Alkalinity (OH)	0.00	-	mg/l
Arsenic, As	0.002	-	mg/l
Cadmium, Cd	L 0.001	-	mg/l
Copper, Cu	L 0.01	-	mg/l
Lead, Pb	L 0.005	-	mg/l
Zinc, Zn	0.02	-	mg/l
Chromium, Cr	L 0.005	-	mg/l
Calcium, Ca	109.00	-	mg/l
Magnesium, Mg	50.60	-	mg/l
Hardness (CaCO3)	481.00	-	mg/l
Manganese, Mn	1.25	-	mg/l
Iron, Fe	1.24	-	mg/l
Sodium, Na	12.00	-	mg/l
Color	-	-	units
Turbidity	4.00	-	NTU
Cyanide, CN	L 0.02	-	mg/l
NO3-NO2-N	L 0.01	-	mg/l
Chloride, Cl	6.00	-	mg/l
Sulphate, SO4	47.00	-	mg/l
Coliform Group	24.00	-	per 100 ml
Fecal Coliform	-	-	per 100 ml

L = Less Than

G = Greater Than

Water Quality Analysis

Project: Phase II Landfill Study

Location: Swan River, R.M. of Swan River. SW-15-36-27W

Sample #: 4

Date: Result A; November 22, 1983 Result B; January 11, 1984

Parameter	Result A	Result B	Measured Unit
Conductivity	581.00	584.00	umho/cm
Residue Total	350.00	390.00	mg/l
Residue Filterable	350.00	390.00	mg/l
Residue Non Filterable	L 5.00	L 5.00	mg/l
pH	7.65	7.70	units
Alkalinity Total (CaCO3)	238.00	230.00	mg/l
Alkalinity (HCO3)	290.00	281.00	mg/l
Alkalinity (CO3)	0.00	0.00	mg/l
Alkalinity (OH)	0.00	0.00	mg/l
Arsenic, As	L 0.001	0.002	mg/l
Cadmium, Cd	L 0.001	L 0.001	mg/l
Copper, Cu	L 0.01	L 0.01	mg/l
Lead, Pb	L 0.005	L 0.005	mg/l
Zinc, Zn	0.05	0.02	mg/l
Chromium, Cr	L 0.005	L 0.005	mg/l
Calcium, Ca	72.00	76.80	mg/l
Magnesium, Mg	28.00	28.40	mg/l
Hardness (CaCO3)	295.00	309.00	mg/l
Manganese, Mn	0.66	0.55	mg/l
Iron, Fe	0.16	0.79	mg/l
Sodium, Na	4.86	6.54	mg/l
Color	-	-	units
Turbidity	1.00	1.00	NTU
Cyanide, CN	L 0.02	L 0.02	mg/l
NO3-NO2-N	5.40	5.20	mg/l
Chloride, Cl	3.00	4.00	mg/l
Sulphate, SO4	53.00	60.00	mg/l
Coliform Group	L 1.00	L 1.00	per 100 ml
Fecal Coliform	-	L 1.00	per 100 ml

L = Less Than

G = Greater Than

4.0 Glossary of Terms

Alluvial Deposits	Earth, sand, gravel and stones and other transported matter which has been washed away and thrown down by river floods and other causes upon land not permanently submerged beneath the waters of lakes and seas.
Aquifer	A formation, group of formations, or part of a formation that is water bearing.
Bedrock	Any solid rock underlying soil, sand, clay, etc.
Bluff	The name given to the high vertical banks of certain rivers.
Bog	A swamp or tract of wet land covered in many cases with peat.
Calcareous	Containing calcium carbonate.
Deep Basin Deposits	Sediment deposited in deep glacial lakes forming extensive flat plains. Geologically depressed areas with thick sediments in the interior and thinner sediments at the edges.
Explosimeter	Combustible gas detector.
Fen	Low land overflowed or covered with water, but producing reeds, sedges, coarse grasses and other aquatic plants. Low marshy tracts of land.
Fractures	Breaks in rocks due to the processes of intensive faulting and folding.
Glacial	Pertains to characteristics of, produced or deposited by, or derived from glaciers.
Glacial Debris	Glacial drift.
Glacial Drift	Sediment in transport in glaciers deposited by glaciers and predominantly of glacial origin.
Glacial Lake Plain	Extensive flat plain formed by sedimentary processes in a glacial lake environment.
Glacial Scouring	The scratching and grooving of a rock surface by glacial erosion.
Glacial Spillway	A channel formed by the outlet streams of glacial dammed lakes.

Glacial Valley Fill	Valley underlain by unconsolidated rock waste derived from the erosion of bordering mountains by passing glaciers.
Glaciofluvial	Pertaining to streams flowing from glaciers or the deposits made by such streams.
Glaciolacustrine	Pertaining to glacial lake conditions. Sediment deposited in lakes marginal to a glacier by glacial meltwater streams.
Groundwater	Water that occurs under water table conditions and to all water in the zone of saturation.
Hummocky	Lumpy or in small uneven knolls.
Hydraulic	Of or pertaining to fluids, conveying or acting by water, operated or moved by means of water.
Hydrogeologic	The science of the distribution and phenomena of subsurface waters.
Ice Marginal	Found along the margin of a glacier, that is, marginal lake, marginal moraine.
I.D.	Inside diametre.
Infiltration	The flow of a fluid into a substance through pores or small opening.
Intermittent	Pertaining to streams or lakes, example; streams which flow part of the time, as during wet weather or after a rainstorm.
Leachate	Liquid derived from the percolation of water through waste separating by solution the more soluble materials in the waste.
Lens	Pertaining to sand, gravel, etc., with the general form of a lens, thick in the central part and thinning towards the edges.
Lodgement Till	Material not carried to the full extent of glacial movement and lodged beneath the glacial margin. Deposited as glacial till.
Moraine	Drift deposited chiefly by direct glacial action, having a topography independent of control by surface forces.
Mud Rotary Drilling	The employment of either or both drilling mud and water during borehole construction.

Outcrop	The part of a stratum which appears at the surface, including those deposites that are so near to the surface and can be found easily by digging.
Outwash	Stratified drift that is stream built deposited by meltwater streams beyond the active glacier.
Percolation	To pass through fine interstices, to filter through, pertaining to waste, porous stones or earth.
Permeable	Pervious, having a texture that permits water to move through it perceptably under the hydraulic head differences ordinarilly found in subsurface conditions.
Pesticide	Any chemical or biological agent used or represented as a means of preventing, destroying, mitigating, controlling, attracting or repelling any pest.
P.R.	Provincial road.
P.T.H.	Provincial Trunk Highway.
Sedimentary	Descriptive term for rock formed of sediment, settling down from suspension in water.
Swale	A slightly marshy depression in land which is generally level.
Swell	A low dome or anticline of considerable areal extent.
T.H.	Test hole.
Till	A stiff clay full of stones varying in size up to boulders.
Topography	The physical features of a district or region especially the relief and contour of the land.
Veneer	A uniform coating of till conforming to the shape of the underlying surface. Usually a thin coating of material deposited in transit.
Water Table	The upper surface of a zone of saturation except where that surface is formed by an impermeable body.

5.0 References

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